

EXHIBIT A

**HONEYWELL INTERNATIONAL INC. AND
HONEYWELL INTELLECTUAL PROPERTIES INC.**

V.

HAMILTON SUNDSTRAND CORP.

No. 99-309-GMS

MARCH 23-24, 2006 TRIAL

**DEPOSITION DESIGNATIONS OF
JAMES CLARK**

DEPOSITION TAKEN: DECEMBER 6-7, 2005

Key:



Hamilton Sundstrand Designations



Honeywell Designations

James Clark Deposition Designations -- Final

Scene	Designation	Source	Tx
1	5:10-5:11	Clark 12/06/2005	
		5: 10 Q. Can you tell us your full name, sir.	
		5: 11 A. Jim Crocker Clark.	
2	7:22-7:23	Clark 12/06/2005	
		7: 22 Q. Okay, Mr. Clark, who do you work for?	
		7: 23 A. Honeywell.	
3	8:7-8:9	Clark 12/06/2005	
		8: 7 Q. How long have you been working for	
		8: 8 Honeywell?	
		8: 9 A. I started there in 1976, September 1st.	
4	8:14-8:17	Clark 12/06/2005	
		8: 14 Q. And when did you receive your master's	
		8: 15 degree from Brigham Young?	
		8: 16 A. Okay, I was continuation there, so I got	
		8: 17 both of them at the same time.	
5	9:22-10:4	Clark 12/06/2005	
		9: 22 Q. Have you worked continuously for	
		9: 23 Honeywell from 1976 through the present?	
		9: 24 A. Yes.	
		9: 25 Q. What's your current job and your	
		10: 1 responsibilities at Honeywell?	
		10: 2 A. My current job is I work in a controls	
		10: 3 analysis group, and engine -- mechanical engineering	
		10: 4 in that group. I do analysis on control systems.	
6	10:14-10:20	Clark 12/06/2005	
		10: 14 Q. What types of things, what types of	
		10: 15 engines do you work on?	
		10: 16 A. I work on what's called auxiliary power	
		10: 17 engines.	
		10: 18 Q. And are you exclusively working on	
		10: 19 auxiliary power engines or, as we call them, APUs?	
		10: 20 A. APUs.	
7	10:24-11:12	Clark 12/06/2005	
		10: 24 Q. What kinds of control systems relating to	
		10: 25 APUs have you worked on throughout your entire time	
		11: 1 at Honeywell, generally, and then we'll talk	
		11: 2 specifically?	
		11: 3 A. Usually on an APU-type engine, you have	
		11: 4 to control the speed, logic to get it started.	
		11: 5 There's usually some type of logic to control its	

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11: 6 temperature, so you don't burn the engine up, and
11: 7 then a lot of our engines that have -- give
11: 8 compressed air to aircrafts, they have some type of
11: 9 surge system, so the air has to be regulated coming
11: 10 out of the compressor, so it won't surge.
11: 11 Q. Is that what you call surge control?
11: 12 A. Surge control.

8 **13:11-14:6** Clark 12/06/2005
13: 11 Q. You also understand, don't you, that the
13: 12 testimony that you're giving today is under oath,
13: 13 correct?
13: 14 A. That's correct.
13: 15 Q. And that the transcript can be read on
13: 16 the video played to the judge when we go to the trial
13: 17 in this case, just as if your testimony were being
13: 18 presented live at trial, you understand that, right?
13: 19 A. Correct.
13: 20 Q. And you also understand that you are
13: 21 being offered today by Honeywell as a corporate
13: 22 representative to testify to the corporation's
13: 23 knowledge as to certain categories in the deposition
13: 24 notice; do you understand that?
13: 25 A. Correct.
14: 1 Q. And so when I ask you questions about
14: 2 what you knew or what Honeywell knew, you understand
14: 3 that your answer should include not only your own
14: 4 personal knowledge, but the knowledge of Honeywell;
14: 5 is that correct?
14: 6 A. Correct.

9 **24:15-24:19** Clark 12/06/2005
24: 15 Q. You have good recollection of the
24: 16 technical things that Honeywell was trying to do in
24: 17 the area of surge control in the late 1970s, early
24: 18 1980s?
24: 19 A. Yes.

10 **24:20-25:12** Clark 12/06/2005
24: 20 Q. Are you familiar with the term "load
24: 21 compressor"?
24: 22 A. That's a term we use to describe part of
24: 23 our APU.
24: 24 Q. And is "load compressor" a term that is
24: 25 limited to APUs?
25: 1 A. Most of my experience is in APUs, so I
25: 2 couldn't answer that.

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25: 3 Q. Do you have any experience in gas turbine
 25: 4 engines outside of the context of APUs?
 25: 5 A. No, I do not.
 25: 6 Q. Do you have any experience with respect
 25: 7 to compressors outside the context of APUs?
 25: 8 A. No, I do not.
 25: 9 Q. So might there be a lot of information
 25: 10 about compressor operation and surge control and
 25: 11 compressors outside the context of APUs that you
 25: 12 might not personally be aware of?

11 **25:15-25:16** Clark 12/06/2005

25: 15 THE WITNESS: Most of my experience is in
 25: 16 APUs and with compressors that go on APUs.

12 **25:18-25:18** Clark 12/06/2005

25: 18 Q. So is the answer to my question yes?

13 **25:21-25:24** Clark 12/06/2005

25: 21 THE WITNESS: I couldn't say that. I
 25: 22 believe what I said before is most of my experience
 25: 23 is with APUs, that's what I've worked in, compressors
 25: 24 and APUs.

14 **26:1-26:6** Clark 12/06/2005

26: 1 Q. So there might be a lot of information
 26: 2 about compressor operation and surge control outside
 26: 3 the context of APUs that you personally might not be
 26: 4 aware of, correct?
 26: 5 A. Oh, I can't state that, because I -- I
 26: 6 don't know that. All I know is what I know on APUs.

15 **28:12-28:20** Clark 12/06/2005

28: 12 Q. How long have you studied load
 28: 13 compressors and their operating characteristics in
 28: 14 the context of APUs?
 28: 15 A. I basically have had the same job since I
 28: 16 signed in September 1st, 19 -- I could not tell you
 28: 17 how long, but it's been part of my -- whenever it
 28: 18 comes up, it's been part of my job.
 28: 19 Q. And is it fair to say that load
 28: 20 compressors have been around for 50 years or more?

16 **28:23-29:15** Clark 12/06/2005

28: 23 THE WITNESS: As far to my knowledge is,
 28: 24 when I signed in, they had not made a load compressor
 28: 25 APU to that time, where I worked.
 29: 1 BY MR. LIND:
 29: 2 Q. Well, when did Honeywell make its first

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29: 3 load compressor APU?
 29: 4 A. Where I worked, consumer power division,
 29: 5 it was around -- I can't tell you the exact dates,
 29: 6 but it was for the F-18 application, and it was -- I
 29: 7 worked on it as soon as I came in there, so it's 1976
 29: 8 to, I could not tell you the date, but it was late
 29: 9 '70s, I should say.
 29: 10 Q. Did you study compressor technology in
 29: 11 school at all?
 29: 12 A. No. Other than classes where we had
 29: 13 thermodynamics and they were telling us about
 29: 14 compressors, I did not take a class called
 29: 15 "Compressors."

17 **30:4-30:8** Clark 12/06/2005
 30: 4 Q. And who are the most recognized experts
 30: 5 in that field of -- as you've stated it?
 30: 6 A. Like I say, I worked in APUs; I don't
 30: 7 know much outside of my people that I work with, so I
 30: 8 don't think I can answer that question.

18 **30:9-30:18** Clark 12/06/2005
 30: 9 Q. Well, who -- do you have any treatises or
 30: 10 text reference books that you refer to as part of
 30: 11 your job?
 30: 12 A. They're fluid mechanics and thermodynamic
 30: 13 books.
 30: 14 Q. And who are the authors of the -- why
 30: 15 don't you tell me the key kind of books that you
 30: 16 reference repeatedly in your control system?
 30: 17 A. My main fluid mechanics book was written
 30: 18 by a man by the name of Shapiro out of MIT.

19 **30:21-31:2** Clark 12/06/2005
 30: 21 Q. And that Shapiro book dates back to when?
 30: 22 A. I believe that dates back to 19 -- early
 30: 23 1950, something like that.
 30: 24 Q. And are the principles discussed about
 30: 25 the fluid dynamics in Shapiro's book dated back to
 31: 1 the 1950s still equally applicable to today's
 31: 2 compressor technology?

20 **31:5-31:6** Clark 12/06/2005
 31: 5 THE WITNESS: The equations, obviously,
 31: 6 are still correct; that's nature.

21 **31:8-31:15** Clark 12/06/2005
 31: 8 Q. How about the -- I mean, to put it
 31: 9 simply, the reason you refer back to a book that is

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31: 10 dated in the 1950s is to help you with solving
 31: 11 today's problems, correct?
 31: 12 A. You refer back there for equations, to
 31: 13 relate flows, how the flows relate to pressures, how
 31: 14 the temperatures relate to compression, these types
 31: 15 of things, those are equations.

22 **33:14-33:17** Clark 12/06/2005

33: 14 Q. Are you familiar with the concept or term
 33: 15 of "inlet guide vanes"?
 33: 16 A. Correct. We use inlet guide vanes on our
 33: 17 APUs.

23 **34:4-34:6** Clark 12/06/2005

34: 4 Q. The position of the inlet guide vanes
 34: 5 changes the flow of air through the compressor?
 34: 6 A. It can. Among other things.

24 **34:7-34:10** Clark 12/06/2005

34: 7 Q. What are the other things?
 34: 8 A. Somebody can change the flow through the
 34: 9 compressor with downstream valves, downstream of the
 34: 10 compressor.

25 **34:11-34:18** Clark 12/06/2005

34: 11 Q. But if you change the position of the
 34: 12 inlet guide vanes in the load compressor, you will
 34: 13 change --
 34: 14 A. You will change the flow.
 34: 15 Q. -- the flow of air through the
 34: 16 compressor, correct?
 34: 17 A. You will change the flow of air through
 34: 18 the compressor.

26 **37:5-37:9** Clark 12/06/2005

37: 5 Q. And that is a -- the concept that if you
 37: 6 open the inlet guide vanes, you're going to get more
 37: 7 flow is a concept that has been around for 50 years
 37: 8 or so, maybe more, correct?
 37: 9 A. I can't say that; I don't know.

27 **37:10-37:18** Clark 12/06/2005

37: 10 Q. The concept that if you open the inlet
 37: 11 guide vanes more, you'll get more air flow through
 37: 12 the compressor is a concept that has been known since
 37: 13 at least when you started working with inlet guide
 37: 14 vanes and load compressors back in the late 1970s,
 37: 15 correct?
 37: 16 A. As far as I know, my first knowledge of

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37: 17 it was at application when I came to work in the
 37: 18 1970s.

28 **38:8-38:15** Clark 12/06/2005

38: 8 Q. Have you ever used the word or term "flow
 38: 9 parameter," "flow-related parameter" in the context
 38: 10 of surge control systems in compressors?
 38: 11 A. A flow-related parameter, for example,
 38: 12 could be a Delta P/P, that total static minus total
 38: 13 divided by the total. P total minus P static,
 38: 14 divided by P total. Or I don't know. I'm driving
 38: 15 the poor court reporter crazy.

29 **38:16-39:4** Clark 12/06/2005

38: 16 Q. What other flow-related parameters, other
 38: 17 than Delta P/P, are you aware of?
 38: 18 A. I can't -- they sometimes, and we don't
 38: 19 do it, but we have looked at systems where you put in
 38: 20 a, what's called a hot wire anemometer, to measure
 38: 21 flow.
 38: 22 Q. And what's the flow-related parameter in
 38: 23 that case?
 38: 24 A. It's a wire that goes through the duct
 38: 25 where the flow is, it's passing, and it changes the
 39: 1 heat transfer of the wire, so what they do is they
 39: 2 measure the current going through the wire; I believe
 39: 3 that you can see how much flow is going past the
 39: 4 wire.

30 **39:8-39:20** Clark 12/06/2005

39: 8 Q. Power -- changes in power through a wire
 39: 9 might be another flow-related parameter?
 39: 10 A. Could be.
 39: 11 Q. Do you know of any other flow-related
 39: 12 parameters?
 39: 13 A. I believe one time we looked at putting
 39: 14 something in there that, as the -- when flow goes
 39: 15 past a cylinder or something, it will vibrate and I
 39: 16 think one time we looked into that as the vibration
 39: 17 of the probe will tell you what flow is.
 39: 18 Q. So vibration of a probe in the compressor
 39: 19 air flow is another flow-related parameter?
 39: 20 A. It could be, yes.

31 **40:13-40:17** Clark 12/06/2005

40: 13 Q. Let me ask you this, have you ever used
 40: 14 the term "flow parameter" or "flow-related parameter"
 40: 15 in your work at Honeywell?

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40: 16 A. In my work at Honeywell, I've never used
40: 17 that term.

32 **41:2-41:19** Clark 12/06/2005

41: 2 Q. So by "flow-related parameter," you mean
41: 3 something in the surge system that tells you what
41: 4 corrected flow is, right?
41: 5 A. Right.
41: 6 Q. Can you look at changes in pressure
41: 7 between one part of the compressor and another part
41: 8 of the compressor to determine what the flow through
41: 9 the compressor is?
41: 10 A. If you put pressure probes in the right
41: 11 place, that is possible.
41: 12 Q. Is it also possible if you use pressure
41: 13 taps instead of pressure probes?
41: 14 A. You can use pressure taps instead of
41: 15 pressure probes.
41: 16 Q. And how long has it been known that you
41: 17 can look at changes in pressure using pressure taps
41: 18 at different areas of the compressor in order to
41: 19 determine what the flow through the compressor is?

33 **41:22-41:25** Clark 12/06/2005

41: 22 THE WITNESS: Certainly we know from
41: 23 fluid mechanics equations that flows are related to
41: 24 pressures; I can't tell you how long people have done
41: 25 that in compressors.

34 **42:2-42:5** Clark 12/06/2005

42: 2 Q. But again, since at least the late 1970s,
42: 3 correct?
42: 4 A. Since I've been working there, that's
42: 5 correct.

35 **42:6-42:22** Clark 12/06/2005

42: 6 Q. Can you look at changes in static
42: 7 pressure using pressure taps at different portions of
42: 8 the compressor to determine flow?
42: 9 A. Are you talking about just one?
42: 10 Q. One what?
42: 11 A. Pressure -- in other words, you could use
42: 12 two statistics and possibly do that.
42: 13 Q. Okay.
42: 14 A. I don't think with just one static you
42: 15 could do that.
42: 16 Q. With one tap you mean?
42: 17 A. One pressure sensor, one tap.

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42: 18 Q. Okay. If you had two different pressure
42: 19 taps at different places along the flow of air
42: 20 through the compressor, measuring static pressure,
42: 21 can you look at the difference in that pressure to
42: 22 determine flow?

36 **42:25-43:5** Clark 12/06/2005

42: 25 THE WITNESS: We're talking about a
43: 1 thing -- we say "flow," what we really mean is this
43: 2 term called "corrected flow," and if you just knew
43: 3 the difference between those two, you could not get
43: 4 the corrected flow; you need another -- you need a
43: 5 division there, a Delta P/P.

37 **43:7-43:18** Clark 12/06/2005

43: 7 Q. Is another way to look at the Delta P/P
43: 8 flow-related parameter to look at the difference in
43: 9 static pressure between two areas in the compressor
43: 10 and divide that by one of those static pressures?
43: 11 A. Could you do that?
43: 12 Q. And when was the first --
43: 13 A. Let me see if I got that straight, my
43: 14 understanding is you're going to take a Delta P
43: 15 between two static pressures and divide it by
43: 16 probably the highest pressure.
43: 17 Q. Correct.
43: 18 A. Okay. You could do that.

38 **43:25-44:2** Clark 12/06/2005

43: 25 Q. When was the first time that you or
44: 1 anyone at Honeywell knew of looking at Delta P/P in
44: 2 terms of just static pressure, as you just described?

39 **44:10-44:13** Clark 12/06/2005

44: 10 A. As far as using pure statics, I think the
44: 11 first time I can remember that we usually -- I really
44: 12 couldn't answer that, because I don't know how a lot
44: 13 of their systems worked.

40 **45:3-45:12** Clark 12/06/2005

45: 3 Q. What's your best recollection of when you
45: 4 first became aware of the flow parameter Delta P/P,
45: 5 using just static pressure measurements?
45: 6 A. Just static pressure measurements, when
45: 7 did I become aware of that, the Delta P/P?
45: 8 Q. Correct.
45: 9 A. I believe we have one application, a
45: 10 165-9 that does that, that uses static pressures.
45: 11 Q. When was Honeywell's application of a

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		45: 12 static pressure Delta P/P first conceived?
41	45:15-45:16	Clark 12/06/2005 45: 15 THE WITNESS: I couldn't give you an 45: 16 exact answer on that, I don't know for sure.
42	45:18-45:18	Clark 12/06/2005 45: 18 Q. Tell me what your best recollection is.
43	45:21-45:21	Clark 12/06/2005 45: 21 THE WITNESS: I don't know.
44	45:23-45:23	Clark 12/06/2005 45: 23 Q. At or near the time you joined Honeywell?
45	45:25-46:1	Clark 12/06/2005 45: 25 THE WITNESS: It was before the time I 46: 1 joined Honeywell.
46	46:3-46:5	Clark 12/06/2005 46: 3 Q. And you joined Honeywell in 1976, 46: 4 correct? 46: 5 A. 1976.
47	46:18-46:23	Clark 12/06/2005 46: 18 Q. And when you're trying to visualize or 46: 19 come up with ways of measuring flow through a 46: 20 compressor, there are certain basic concepts going 46: 21 back to at least Shapiro's 1950s book that any 46: 22 engineer in your shoes trying to determine flow rates 46: 23 are aware of and know of, correct?
48	47:1-47:2	Clark 12/06/2005 47: 1 THE WITNESS: I don't think I could agree 47: 2 with that.
49	47:25-47:25	Clark 12/06/2005 47: 25 Q. Is Shapiro's 1950s textbook a book that
50	48:1-48:7	Clark 12/06/2005 48: 1 you recommend to your colleagues for basic flow 48: 2 principles and -- principles of air flow through a 48: 3 compressor? 48: 4 A. Not through a compressor, it's a classic 48: 5 book on fluid mechanics; I believe the title of the 48: 6 book is "The Dynamics and Thermodynamics of 48: 7 Compressible Fluid Flow."
51	48:8-48:19	Clark 12/06/2005 48: 8 Q. When you're recommending -- well, is the 48: 9 Shapiro book from the 1950s a book that you recommend 48: 10 to your colleagues for looking at issues relating to

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48: 11 thermodynamics and compressible fluid flow?
 48: 12 A. That's correct.
 48: 13 Q. Is that a book that you've referred to
 48: 14 going back to your original work at Honeywell in the
 48: 15 late 1970s?
 48: 16 A. That was a textbook of mine.
 48: 17 Q. And was that a textbook that you got in
 48: 18 college?
 48: 19 A. Yes.

52 **48:19-49:3** Clark 12/06/2005

48: 19 A. Yes.
 48: 20 Q. You mentioned an APU called the 165-9;
 48: 21 what airplanes did that APU go on?
 48: 22 A. That goes on the B-1.
 48: 23 Q. And how did the surge control system in
 48: 24 the 165-9 APU work?
 48: 25 A. I didn't -- I worked on it a little bit,
 49: 1 but not a whole lot; it was developed before I was
 49: 2 there, so I couldn't give you a real good answer on
 49: 3 how that works.

53 **49:4-49:20** Clark 12/06/2005

49: 4 Q. What's your understanding of how it
 49: 5 works, based on the understanding that you have?
 49: 6 A. There's a surge valve and it senses this
 49: 7 Delta P/ -- it senses -- it's been changed several
 49: 8 times. There's -- there's been upgrades, okay?
 49: 9 Originally, it just sensed a Delta P, I believe. It
 49: 10 was not a Delta P/P control, as I recall.
 49: 11 Q. When the --
 49: 12 A. And they use a -- and I believe it's
 49: 13 really two statics there, but it's not a Delta P/P.
 49: 14 Q. When the 165-9 APU surge control system
 49: 15 originally sensed just Delta P, that was in order to
 49: 16 determine air flow through the compressor?
 49: 17 A. It -- it uses that Delta P as a set point
 49: 18 to modulate the surge control valve; that means to
 49: 19 open up and protect the unit when the Delta P gets to
 49: 20 a certain level.

54 **49:21-50:1** Clark 12/06/2005

49: 21 Q. In the 165-9 original surge control
 49: 22 system, did it measure the difference in two static
 49: 23 pressures in order to know whether to open or how
 49: 24 much to open the surge control valve?
 49: 25 A. It used those two static pressures to

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		50: 1 control a surge control valve.
55	55:6-55:7	Clark 12/06/2005
	55: 6	Q. And that's the same reason for the shape
	55: 7	or geometry of the diffuser, correct?
56	55:11-55:12	Clark 12/06/2005
	55: 11	THE WITNESS: The purpose of the diffuser
	55: 12	in the compressor is to slow the flow down.
57	55:14-55:25	Clark 12/06/2005
	55: 14	Q. The purpose of a -- the back end of a
	55: 15	Venturi is also to increase pressure, correct, at the
	55: 16	discharge?
	55: 17	A. When you slow the flow down, the static
	55: 18	pressure comes up.
	55: 19	Q. And that principle applies whether you're
	55: 20	in a back end of a Venturi or in a diffuser, correct?
	55: 21	A. That principle works on fluids, so it
	55: 22	doesn't matter where the fluid is.
	55: 23	Q. And that, again, is a principle that you
	55: 24	have understood since studying fluid dynamics back in
	55: 25	college, right?
58	56:1-56:2	Clark 12/06/2005
	56: 1	A. Venturis are a familiar principle.
	56: 2	Q. Is that a yes?
59	58:24-59:4	Clark 12/06/2005
	58: 24	Q. Sure. The lowest pressure in a
	58: 25	converging/diverging nozzle is generally at the
	59: 1	throat of the nozzle, correct?
	59: 2	A. It depends on how much you back-pressure
	59: 3	the nozzle. It can be -- the discharge can be
	59: 4	greater or it can be less than the throat.
60	59:5-59:18	Clark 12/06/2005
	59: 5	Q. When you have subsonic flow through a
	59: 6	converging/diverging nozzle, you'll have lower
	59: 7	pressure at the throat than at the discharge,
	59: 8	correct?
	59: 9	A. When you have subsonic flow.
	59: 10	Q. And when you have supersonic flow in a
	59: 11	converging/diverging nozzle, you can have lower
	59: 12	pressure actually at the back end of that nozzle,
	59: 13	correct?
	59: 14	A. When you have supersonic flow, you can
	59: 15	get a shockwave in there and you'll have lower
	59: 16	pressure than at the throat.

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59: 17 Q. And those same principles apply to a
 59: 18 diffuser, correct?

61 **59:20 -59:21** Clark 12/06/2005
 59: 20 THE WITNESS: Those same principles in
 59: 21 the areas expanding, that's true.

62 **59:23 -60:3** Clark 12/06/2005
 59: 23 Q. And those are principles that you have
 59: 24 understood and learned about going, again, back to
 59: 25 your college days, correct?
 60: 1 A. Those are in my textbook.
 60: 2 Q. In your 1950s Shapiro textbook?
 60: 3 A. Right.

63 **60:4 -60:6** Clark 12/06/2005
 60: 4 Q. Do -- does the position of the inlet
 60: 5 guide vanes affect the flow-related parameter in a
 60: 6 surge control system?

64 **60:9 -60:11** Clark 12/06/2005
 60: 9 THE WITNESS: Can you -- I've already
 60: 10 stated you can change the inlet guide vanes and
 60: 11 change flow.

65 **60:13 -60:15** Clark 12/06/2005
 60: 13 Q. And if you change the inlet guide vanes
 60: 14 and change flow, you're going to change the value of
 60: 15 the flow-related parameter, correct?

66 **60:17 -60:19** Clark 12/06/2005
 60: 17 THE WITNESS: If you change the inlet
 60: 18 guide vanes and change flow, the flow rate parameter
 60: 19 is going to change.

67 **60:21 -61:1** Clark 12/06/2005
 60: 21 Q. And that's because the pressures that are
 60: 22 being measured in the flow-related parameter are
 60: 23 going to change because of the change in the inlet
 60: 24 guide vane pressure?
 60: 25 A. The pressures are changing because the
 61: 1 flow is changing.

68 **61:5 -61:8** Clark 12/06/2005
 61: 5 Q. Were -- did the 165-9 APU have inlet
 61: 6 guide vanes?
 61: 7 A. The 165-9 does not have inlet guide
 61: 8 vanes.

69 **61:19 -61:25** Clark 12/06/2005
 61: 19 Q. Are you familiar with the concept of

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61: 20 compressor surge?
 61: 21 A. Yes, I've heard of compressor surge.
 61: 22 I've worked on surge systems, so I'm familiar with
 61: 23 the concept.
 61: 24 Q. And again, the concept of compressor
 61: 25 surge is a concept that goes back to your college

70 **62:1-62:8** Clark 12/06/2005
 62: 1 days and Shapiro?
 62: 2 A. Before I came to work, I had never heard
 62: 3 of compressor surge.
 62: 4 Q. So you had heard of compressor surge at
 62: 5 least as of 1976?
 62: 6 A. When I came to work I heard of compressor
 62: 7 surge; I don't know exactly when after I came, but I
 62: 8 learned of it at work.

71 **63:2-63:4** Clark 12/06/2005
 63: 2 Q. And how long has the concept of
 63: 3 compressor surge been known?
 63: 4 A. I couldn't answer that.

72 **64:14-64:25** Clark 12/06/2005
 64: 14 Q. So to create a minimum air flow and avoid
 64: 15 surge, you need to have enough air leaving the
 64: 16 compressor to keep the flow rate at the minimum rate,
 64: 17 correct?
 64: 18 A. That's true. Then that flow rate is a
 64: 19 function of other things.
 64: 20 Q. Sure. And one way you'll get flow
 64: 21 through the compressor is the demand by the customer,
 64: 22 that is, for instance, demand for air for the air
 64: 23 conditioning, correct?
 64: 24 A. The customer can completely cut off the
 64: 25 flow.

73 **66:24-67:2** Clark 12/06/2005
 66: 24 Q. Do you know what a compressor map is?
 66: 25 A. A compressor map is a relationship of the
 67: 1 compressor flow and its output pressure; it's a
 67: 2 functional relationship on a graph.

74 **67:15-67:20** Clark 12/06/2005
 67: 15 Q. And when was the first time that you
 67: 16 personally ever saw a compressor map?
 67: 17 A. The first time I believe I saw a
 67: 18 compressor map was when I went to work for Honeywell.
 67: 19 Q. So in the late 1970s?
 67: 20 A. Sometime in the late 1970s.

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75	67:21-67:25	Clark 12/06/2005 67: 21 Q. But you understood compressor maps to 67: 22 have been something that had been around for many 67: 23 years before you joined Honeywell, correct? 67: 24 MS. STEVENSON: Object to the form, lacks 67: 25 foundation.
76	68:1-68:2	Clark 12/06/2005 68: 1 THE WITNESS: I don't know. I couldn't 68: 2 answer that question.
77	68:13-68:13	Clark 12/06/2005 68: 13 (Marked for identification Exhibit 3.)
78	68:21-68:22	Clark 12/06/2005 68: 21 Q. And is this a typical representation of 68: 22 the flow characteristics of a compressor?
79	68:24-68:25	Clark 12/06/2005 68: 24 THE WITNESS: This looks like a generic 68: 25 compressor map.
80	69:10-69:12	Clark 12/06/2005 69: 10 Q. And this compressor -- generic compressor 69: 11 map is similar to the compressor maps in that respect 69: 12 that you worked with at Honeywell?
81	69:17-69:17	Clark 12/06/2005 69: 17 A. It's the same form.
82	70:12-70:21	Clark 12/06/2005 70: 12 Q. And am I right that each of those IGV 70: 13 lines shows the operating characteristics of a 70: 14 compressor at a specific inlet guide vane position? 70: 15 MS. STEVENSON: Objection; lacks 70: 16 foundation. 70: 17 THE WITNESS: Not correct. Those lines 70: 18 the speed of the compressor is held constant, the IGV 70: 19 is held constant, and then the back pressure is -- or 70: 20 a valve or something is moved downstream of the valve 70: 21 to create this line.
83	71:11-71:18	Clark 12/06/2005 71: 11 Q. And in a compressor map like Exhibit 3, 71: 12 surge occurs at the left-most point on the IGV line, 71: 13 correct? 71: 14 A. At the lowest flow. 71: 15 Q. And is that the left-most point on each 71: 16 individual IGV line? 71: 17 A. The lowest flow is the most-left point

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		71: 18	there, right.
84	71:19-71:25	Clark 12/06/2005	
		71: 19	Q. Does --
		71: 20	A. The graph begins at low flow and goes to
		71: 21	high flow.
		71: 22	Q. The left side of X axis is low flow and
		71: 23	the right side is high flow --
		71: 24	A. That's correct.
		71: 25	Q. -- right?
85	72:1-72:4	Clark 12/06/2005	
		72: 1	And the bottom of the Y axis is lower
		72: 2	pressure ratio and the top of the Y axis is higher
		72: 3	pressure ratio?
		72: 4	A. Higher pressure ratio.
86	73:6-73:8	Clark 12/06/2005	
		73: 6	Q. So the bottom-most IGV line is for a --
		73: 7	one IGV position, and the top IGV line, for instance,
		73: 8	is for another IGV position or inlet?
87	73:11-73:11	Clark 12/06/2005	
		73: 11	THE WITNESS: If the speed is the same.
88	73:13-73:17	Clark 12/06/2005	
		73: 13	Q. Correct. And if the speed is the same,
		73: 14	the top IGV line is going to be the IGV line where
		73: 15	the guide vanes are more open than the bottom,
		73: 16	correct?
		73: 17	A. That's correct.
89	76:5-77:6	Clark 12/06/2005	
		76: 5	Q. In order to avoid, in your words, robbing
		76: 6	the customer of the air for, say, air conditioning,
		76: 7	you want to avoid surge, but you want to operate
		76: 8	pretty much as close to that surge line as possible;
		76: 9	isn't that right?
		76: 10	MS. STEVENSON: Objection; vague,
		76: 11	incomplete hypothetical.
		76: 12	THE WITNESS: You want to have the surge
		76: 13	control system keep you out -- you have to have it
		76: 14	full enough to keep you out of surge. You cannot
		76: 15	pick the flow that's right at surge, because due to
		76: 16	tolerances and everything, that won't work. So you
		76: 17	have to back away from there a certain amount to
		76: 18	allow for tolerances or whatever in your system.
		76: 19	BY MR. LIND:
		76: 20	Q. You need a safety margin?

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76: 21 A. You need a margin.
 76: 22 Q. But recognizing that you have to have
 76: 23 some margin in order to -- in order to not rob the
 76: 24 customer of air, you want to operate, I guess, as
 76: 25 close to that margin anyhow, continuously, as you
 77: 1 can, right?
 77: 2 MS. STEVENSON: Objection; vague.
 77: 3 THE WITNESS: It depends on -- not
 77: 4 necessarily. The customer usually tells you where --
 77: 5 you want to operate at a point where you're not
 77: 6 interfering with the customer's flow.

90 **79:18-79:24** Clark 12/06/2005

79: 18 Q. And you want to stay as close to that air
 79: 19 flow as you can without going into surge, correct?
 79: 20 MS. STEVENSON: Objection; incomplete
 79: 21 hypothetical, lacks foundation.
 79: 22 THE WITNESS: No, no, you just -- you
 79: 23 don't want surge, and you want to give the customer
 79: 24 the flow.

91 **80:1-80:13** Clark 12/06/2005

80: 1 Q. All right. So to recap these IGV lines,
 80: 2 they're in a compressor map and there's a different
 80: 3 compressor operating curve for each IGV position when
 80: 4 you hold the speed constant, correct?
 80: 5 A. That's right.
 80: 6 Q. And so your IGV position or angle is
 80: 7 going to affect where you are on the compressor map,
 80: 8 correct?
 80: 9 A. It shifts those lines.
 80: 10 Q. So if you have one IGV position, you're
 80: 11 going to be at a different line on the compressor map
 80: 12 than if you had a second IGV position, correct?
 80: 13 A. Considering the speed, that's correct.

92 **80:25-81:20** Clark 12/06/2005

80: 25 Q. Did you understand that the principle
 81: 1 that IGV lines affect where you are in a compressor
 81: 2 map was something that engineers knew going back
 81: 3 before you joined Honeywell?
 81: 4 A. I couldn't say that. I don't know.
 81: 5 Q. So you think that that's something that
 81: 6 Honeywell discovered?
 81: 7 MS. STEVENSON: Objection; misstates the
 81: 8 witness's testimony.
 81: 9 THE WITNESS: I don't know who invented

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81: 10 IGVs.
 81: 11 BY MR. LIND:
 81: 12 Q. You knew that inlet guide vanes were
 81: 13 around prior to you joining Honeywell, correct?
 81: 14 A. I had never heard of IGVs before I joined
 81: 15 Honeywell.
 81: 16 Q. Do you have any reason to believe that
 81: 17 IGVs did not exist prior to you joining Honeywell?
 81: 18 MS. STEVENSON: Objection; calls for
 81: 19 speculation.
 81: 20 THE WITNESS: I can't say.

93 **82:1-82:8** Clark 12/06/2005

82: 1 Q. You really can't tell me whether you have
 82: 2 an understanding whether inlet guide vanes existed
 82: 3 prior to 1976?
 82: 4 MS. STEVENSON: Objection; argumentative
 82: 5 and asked and answered.
 82: 6 THE WITNESS: I had no -- I had no
 82: 7 knowledge of it, and I can't tell you whether they
 82: 8 did or not.

94 **82:10-83:3** Clark 12/06/2005

82: 10 Q. Are you familiar with the term "set
 82: 11 point" in the context of surge control?
 82: 12 A. Set point is a standard control term;
 82: 13 feedback control you're usually trying to hold
 82: 14 something at level, so in surge controls standard
 82: 15 control there would be a set point.
 82: 16 Q. And a set point of a surge control system
 82: 17 is the minimum flow you want to maintain in order to
 82: 18 avoid surge?
 82: 19 A. What we really sense there -- it's
 82: 20 whatever you're sensing; it may be Delta P/P. If
 82: 21 you're sensing Delta P/P, you can relate that to
 82: 22 some, it's not really flow, it's corrected flow
 82: 23 coming out of there, discharged corrected flow. So
 82: 24 you'd be sending it to some corrected discharge flow
 82: 25 would be your set point.
 83: 1 Q. So in the context of surge control
 83: 2 system, your set point is the minimum corrected flow
 83: 3 that you want to maintain to avoid surge?

95 **83:7-83:16** Clark 12/06/2005

83: 7 THE WITNESS: If that's what you're
 83: 8 controlling on. Maybe you have a curve that relates
 83: 9 that to Delta P/P, you -- you're not sensing

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83: 10 corrected flow directly; there is nothing out there,
 83: 11 a meter that says this is a corrected flow meter.
 83: 12 BY MR. LIND:
 83: 13 Q. Is the set point in the context of
 83: 14 correcting or controlling for surge the flow-related
 83: 15 parameter that you want to maintain in order to avoid
 83: 16 surge?

96 **83:19-83:25** Clark 12/06/2005
 83: 19 THE WITNESS: It could be a flow-related
 83: 20 parameter.
 83: 21 BY MR. LIND:
 83: 22 Q. What else could the set point be in the
 83: 23 context of surge control?
 83: 24 A. For example, you look at these curves,
 83: 25 somebody could -- if you weren't worried about these

97 **84:1-84:5** Clark 12/06/2005
 84: 1 IGV angles and speed lines, you could use simple
 84: 2 pressure.
 84: 3 Q. In what context of surge control in an
 84: 4 APU would you not be worried about IGV lines?
 84: 5 A. If you -- all APUs don't have IGVs.

98 **89:1-89:4** Clark 12/06/2005
 89: 1 Q. Based on your knowledge of compressor
 89: 2 maps and thermodynamic principles, in general, does
 89: 3 it make sense to use inlet guide vane position as an
 89: 4 input in a surge control system?

99 **89:6-89:9** Clark 12/06/2005
 89: 6 THE WITNESS: The -- when you lower the
 89: 7 inlet guide vane position, the compressor surges at a
 89: 8 lower corrected flow, so you like to take advantage
 89: 9 of that.

100 **89:11-89:16** Clark 12/06/2005
 89: 11 Q. And is that a principle that you knew of
 89: 12 when you started working at Honeywell in the late
 89: 13 1970s?
 89: 14 A. I think I tried to answer that. We knew
 89: 15 that when we started the F-18 development, which was
 89: 16 done in the 1970s.

101 **90:2-90:7** Clark 12/06/2005
 90: 2 Q. Mr. Clark, in the late 1970s in
 90: 3 connection with the F-18 aircraft, Honeywell used
 90: 4 inlet guide vane position as an input into its surge
 90: 5 control system, correct?

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90: 6 A. No. It's a fully pneumatic system and it
90: 7 did not use inlet guide vane position.

102 **91:20-91:25** Clark 12/06/2005

91: 20 Q. And you know of surge control systems
91: 21 that you've talked about that could use a flow
91: 22 parameter based on either static pressure alone or a
91: 23 combination of static and total pressure
91: 24 measurements, correct?
91: 25 A. I think I said earlier you couldn't just

103 **92:1-92:2** Clark 12/06/2005

92: 1 use one pressure, static pressure as a flow-related
92: 2 parameter; that was your question, correct?

104 **92:3-92:18** Clark 12/06/2005

92: 3 Q. You could take the difference between two
92: 4 static pressure measurements at two different places
92: 5 in the compressor, correct?
92: 6 A. Correct, you need two.
92: 7 Q. As a flow-related parameter?
92: 8 A. As a flow-related parameter.
92: 9 Q. You could also compare measurements of
92: 10 static pressure and total pressure as a flow-related
92: 11 parameter in a surge control system, correct?
92: 12 A. That's correct.
92: 13 Q. And that's a concept that you've been
92: 14 familiar with for how long?
92: 15 A. Since I've been at Honeywell.
92: 16 Q. And the same with the two static pressure
92: 17 tap systems, correct?
92: 18 A. Right.

105 **92:23-93:25** Clark 12/06/2005

92: 23 THE WITNESS: The static -- the limiting
92: 24 factor is the static pressure measurements -- there
92: 25 will be a branch that goes to the -- a pipe that goes
93: 1 to the customer, and a pipe that goes to the surge
93: 2 valve, okay, you have to be between the compressor
93: 3 and a branch in those two pipes. In other words, the
93: 4 static pressure has -- the total flow has -- it has
93: 5 to be in a region where the total flow coming out of
93: 6 the compressor is -- because that's what you're
93: 7 trying to control --
93: 8 BY MR. LIND:
93: 9 Q. Can you take static pressure measurements
93: 10 in a surge control system in the pipe what you call
93: 11 going to the surge bleed valve?

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93: 12 A. That -- no.
 93: 13 Q. Can you take static pressure measurements
 93: 14 to determine your flow-related parameter in the, what
 93: 15 you called the pipe going to the customer, the
 93: 16 airplane?
 93: 17 A. No, no. It's got to be someplace where
 93: 18 the total flow flows through that cross-sectional
 93: 19 area where the static port is. "Total flow" meaning
 93: 20 all the flow that the compressor is putting out.
 93: 21 Q. Is what you called the pipe going to
 93: 22 the --
 93: 23 A. We're talking about load compressors now;
 93: 24 is that right?
 93: 25 Q. Correct.

106 **94:1-94:21** Clark 12/06/2005

94: 1 A. We're not talking about other -- there's
 94: 2 integral bleed engines and we have load compressor,
 94: 3 we're talking about load compressors.
 94: 4 Q. Let's talk about load compressors for
 94: 5 now. The pipe that you referred to as going to the
 94: 6 customer, the airplane, is that also the diffuser?
 94: 7 A. I wouldn't think so.
 94: 8 Q. Where does the diffuser exist in relation
 94: 9 to what you call the split in the pipes, one that
 94: 10 goes to the surge bleed valve, one that goes to the
 94: 11 customer?
 94: 12 A. Compressors are made up of an impeller,
 94: 13 I'm talking about centrifugal compressors, that's
 94: 14 what I know about, they're usually load compressors,
 94: 15 an impeller, that's the thing that's spinning, and
 94: 16 then the flow goes out of the impeller into the
 94: 17 diffuser. And then the diffuser slows down the air
 94: 18 and it dumps into what's called scroll and the scroll
 94: 19 collects all that diffuser flow, and there's usually
 94: 20 a single port that comes out of, and that will go and
 94: 21 branch to the customer or to the surge valve.

107 **94:22-95:5** Clark 12/06/2005

94: 22 Q. So when you're talking about static
 94: 23 pressure measurements, you can take static pressure
 94: 24 measurements to determine your flow parameter in a
 94: 25 surge control system within the diffuser itself,
 95: 1 correct?
 95: 2 A. That's correct.
 95: 3 Q. And you can also take total pressure
 95: 4 measurements within the diffuser, correct?

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95: 5 A. That would be correct.

108 **96:12-96:23** Clark 12/06/2005
 96: 12 Q. And there are disadvantages to measuring
 96: 13 total flow within the diffuser at least, because you
 96: 14 have to stick the tube in there --
 96: 15 A. You have to stick the tube in.
 96: 16 Q. And you lose some power, right?
 96: 17 A. Right.
 96: 18 Q. And that's a principle that you knew
 96: 19 about measuring pressure coming into Honeywell in the
 96: 20 late 1970s, correct?
 96: 21 A. I don't know if I knew that coming in,
 96: 22 but the aerodynamicists certainly told me to get that
 96: 23 thing out of the diffuser.

109 **96:24-97:3** Clark 12/06/2005
 96: 24 Q. And it makes sense that if you're going
 96: 25 to be in the diffuser, you don't want to stick a
 97: 1 pitot tube necessary --
 97: 2 A. It's where the air is moving the
 97: 3 fastest --

110 **97:4-97:9** Clark 12/06/2005
 97: 4 Q. -- it makes sense based on the
 97: 5 thermodynamic principles back to Shapiro that if
 97: 6 you're going to measure pressure in a diffuser, you
 97: 7 don't want to stick a pitot tube in there to measure
 97: 8 total pressure, because you're going to lose power,
 97: 9 correct?

111 **97:11-97:13** Clark 12/06/2005
 97: 11 THE WITNESS: You don't want to stick it
 97: 12 in there because it's going to cause a loss in
 97: 13 performance.

112 **97:15-97:20** Clark 12/06/2005
 97: 15 Q. And so it's general knowledge, dating
 97: 16 back to when you started at Honeywell, that if you're
 97: 17 going to pressure in the diffuser, you're going to
 97: 18 want to measure static pressure, correct?
 97: 19 A. You're going to want to measure static
 97: 20 pressure.

113 **97:21-97:25** Clark 12/06/2005
 97: 21 Q. Is there -- are there advantages when
 97: 22 you're measuring static pressure to measure it in the
 97: 23 diffuser, as opposed to elsewhere?
 97: 24 A. The advantages -- there's disadvantages

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97: 25 and disadvantages (sic). The advantages of

114	98:1-98:2	Clark 12/06/2005 98: 1 measuring, you get a larger Delta P, that's an 98: 2 advantage.
115	98:3-98:7	Clark 12/06/2005 98: 3 Q. So one advantage to measuring static 98: 4 pressure in the diffuser, as opposed to somewhere 98: 5 else in the compressor, is that you will get a larger 98: 6 Delta P, correct? 98: 7 A. That's correct.
116	99:1-99:5	Clark 12/06/2005 99: 1 Q. Having a larger Delta P makes the 99: 2 equipment used in the surge control system more 99: 3 reliable? 99: 4 A. It makes the equipment -- it makes the -- 99: 5 well, the Delta P sensor more reliable.
117	99:14-99:16	Clark 12/06/2005 99: 14 Q. And again, that's a principle that you 99: 15 learned upon coming to Honeywell in the late 1970s, 99: 16 correct?
118	99:18-99:24	Clark 12/06/2005 99: 18 THE WITNESS: Before I came to Honeywell 99: 19 I didn't even know about compressors and diffusers, 99: 20 so I didn't know that until I started working at 99: 21 Honeywell. 99: 22 BY MR. LIND: 99: 23 Q. Which was in the late 1970s, correct? 99: 24 A. Late 1970s.
119	100:15-100:21	Clark 12/06/2005 100: 15 THE WITNESS: I believe the previous 100: 16 question was you knew about putting the static 100: 17 pressure in the diffuser would give you the largest 100: 18 signal, and then I responded, then it got to we knew 100: 19 that in the late 1970s, and I can't agree with the 100: 20 late 1970s, I'm not sure when we knew that that would 100: 21 give us the largest signal or when I knew that.
120	101:1-101:3	Clark 12/06/2005 101: 1 Q. What other advantages occur from taking 101: 2 static pressure measurements in the diffuser when 101: 3 designing a surge control system?
121	101:5-101:16	Clark 12/06/2005 101: 5 THE WITNESS: One of the advantages is

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101: 6 some of our APUs we usually like to put it after --
 101: 7 there's a small duct between the exit of the scroll
 101: 8 and the T that goes from the surge valve and the
 101: 9 customer, okay, and we like to put it in there. On
 101: 10 some APUs, because of the compartment it has to fit
 101: 11 in, it squeezes it real tight; there's not enough
 101: 12 room for that, so a convenient spot was to put it --
 101: 13 obviously, you have to move it someplace else, you
 101: 14 could put it in the scroll or you could put it in the
 101: 15 diffuser. The answer to the question is space
 101: 16 limitations would be an advantage.

122 **107:15-107:25** Clark 12/06/2005

107: 15 Q. Have you heard of the term "DEL P QP"?
 107: 16 And for the record that's capital D;
 107: 17 capital E, capital L, capital P, capital Q, capital
 107: 18 P.
 107: 19 A. I believe it's in one of these, and
 107: 20 that's the first time I saw it.
 107: 21 Q. When you say "in one of these" what are
 107: 22 you referring to?
 107: 23 A. Let me see if I can find it. Okay, this
 107: 24 is -- how do I say this, Deposition Exhibit --
 107: 25 Q. Exhibit 1?

123 **108:1-108:12** Clark 12/06/2005

108: 1 A. Exhibit 1. Okay, it's Exhibit 1,
 108: 2 attachment A, there's a paragraph 1 and C.
 108: 3 Q. Okay. And that's the first time you
 108: 4 believe -- and you reviewed that document for the
 108: 5 first time yesterday, you said, right?
 108: 6 A. That's correct.
 108: 7 Q. And that, you believe, is the first time
 108: 8 you've seen the DEL P QP characterization?
 108: 9 A. That's correct.
 108: 10 Q. Do you have an understanding as to what
 108: 11 DEL P QP is?
 108: 12 A. No, I don't.

124 **109:3-109:11** Clark 12/06/2005

109: 3 Q. Let me ask you again, in your development
 109: 4 of the 331-200 surge control system, you understood
 109: 5 that the flow-related parameters and the surge set
 109: 6 point were a function of inlet guide vane position,
 109: 7 correct?
 109: 8 A. That's -- I believe that's correct.
 109: 9 Q. And in the 331-250 series, the same

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109: 10 thing's correct?
109: 11 A. The same thing is correct.

125 **109:12-109:15** Clark 12/06/2005

109: 12 Q. And in the TSCP-700 surge control system
109: 13 that would also be correct?
109: 14 A. No. A TSCP-700 does not have inlet guide
109: 15 vanes.

126 **109:19-110:4** Clark 12/06/2005

109: 19 Q. What's choked flow?
109: 20 A. Choked flow is -- the flow we call choked
109: 21 is when it goes sonic in a certain area of the duct
109: 22 cross-sectionally in the duct. Once it goes sonic,
109: 23 you can't get any more corrected flow through there,
109: 24 that's it.
109: 25 Q. And is this concept of choked flow that
110: 1 you just described something that you studied back in
110: 2 school --
110: 3 A. That's a fluid mechanics principle that I
110: 4 studied in school.

127 **110:7-110:15** Clark 12/06/2005

110: 7 Q. And when you have choked flow, you still
110: 8 have -- you can have supersonic flow downstream of
110: 9 the choke, correct?
110: 10 A. You can have -- if you're having a
110: 11 diverging nozzle, you can have supersonic flow
110: 12 downstream with a choked flow.
110: 13 Q. And when you say "a diverging nozzle," an
110: 14 example would be a diffuser, correct?
110: 15 A. A diffuser.

128 **111:4-111:5** Clark 12/06/2005

111: 4 Q. If you look back at Exhibit 3, it's by
111: 5 your right hand there.

129 **111:6-111:15** Clark 12/06/2005

111: 6 If we look at any one of the IGV lines,
111: 7 you talked about before that the left-most point on
111: 8 the IGV line is where surge occurs, correct?
111: 9 A. That's -- the left point is the surge
111: 10 line, as labeled, yes.
111: 11 Q. And the right-most, is there a name or a
111: 12 term for the right-most point of the IGV lines shown
111: 13 on a generic compressor map like this?
111: 14 A. The right-most flow would be the -- is
111: 15 usually called the choked flow.

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130 **111:16-111:25** Clark 12/06/2005
 111: 16 Q. So you could also draw a line on Exhibit
 111: 17 3 connecting the right most points, and that would be
 111: 18 a choked flow line, correct?
 111: 19 A. The choked flow line is usually a
 111: 20 vertical line like this, it usually parallels the Y
 111: 21 axis.
 111: 22 Q. For each particular inlet guide vane?
 111: 23 A. For each particular inlet guide vane.
 111: 24 Q. But the surge line in Exhibit 3 is a line
 111: 25 that's connecting each point in surge, right?

131 **112:1-112:9** Clark 12/06/2005
 112: 1 A. That's correct, on each speed IGV line.
 112: 2 Q. Correct. And similarly, you could
 112: 3 connect the end points or right-hand points of the
 112: 4 IGV lines to show where a choke occurs for each IGV
 112: 5 line, correct?
 112: 6 A. I'm trying to explain, those things are
 112: 7 usually vertical, so it gets hard to find an end
 112: 8 point, the line just goes vertical, so -- but where
 112: 9 it goes vertical we call it choke flow.

132 **112:19-112:25** Clark 12/06/2005
 112: 19 Q. And that's something that you can tell by
 112: 20 just looking at the compressor map IGV lines and
 112: 21 seeing where they start to turn vertical, you can
 112: 22 tell where choked flow occurs, correct?
 112: 23 A. Well, you look down and see where the
 112: 24 vertical line goes on the axis and you see that's
 112: 25 choked flow.

133 **113:22-113:25** Clark 12/06/2005
 113: 22 Q. Are you familiar with what's been called
 113: 23 in this case the "inverted V" or the "double solution
 113: 24 problem"?
 113: 25 A. I'm familiar with that.

134 **115:8-115:25** Clark 12/06/2005
 115: 8 Q. And the principles of choked flow and
 115: 9 supersonic flow and the shockwave causing
 115: 10 interference and measuring what actual flow is, those
 115: 11 are all principles that go back again to your study
 115: 12 of fluid dynamics in college and graduate school,
 115: 13 correct?
 115: 14 MS. STEVENSON: Objection; compound.
 115: 15 THE WITNESS: Well, we knew about
 115: 16 shockwaves; we weren't necessarily thinking about

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115: 17 making a Delta P sensor across there.
 115: 18 BY MR. LIND:
 115: 19 Q. Put aside the Delta P sensor, you knew
 115: 20 that when you had choked flow you could get
 115: 21 supersonic flow and a shockwave that would disrupt
 115: 22 any measurement of actual flow back when you studied
 115: 23 that in college?
 115: 24 A. You're right up to the point I knew there
 115: 25 were shockwaves, then you put the word "measurement"

135 **116:1-116:1** Clark 12/06/2005

116: 1 in there; I'm not sure I would agree with that.

136 **116:2-116:14** Clark 12/06/2005

116: 2 Q. Okay. When you studied fluid dynamics in
 116: 3 college you knew that when you had a situation of
 116: 4 choked flow, you could get supersonic flow downstream
 116: 5 in the diffuser, correct?
 116: 6 A. Correct.
 116: 7 Q. And you also knew that you could get a
 116: 8 shockwave, correct?
 116: 9 A. Correct.
 116: 10 Q. And you also knew at the time that if you
 116: 11 got a shockwave, you might have a pressure -- an
 116: 12 apparent pressure differential along the diffuser
 116: 13 that was not representative of what the actual flow
 116: 14 was, correct?

137 **116:16-116:18** Clark 12/06/2005

116: 16 THE WITNESS: I'm getting back to flow
 116: 17 sensor now, I knew that there was pressure drop
 116: 18 across the shockwave.

138 **116:20-116:22** Clark 12/06/2005

116: 20 Q. Okay. And so you knew that --
 116: 21 A. A loss of total pressure across the
 116: 22 shockwave.

139 **117:5-117:24** Clark 12/06/2005

117: 5 Q. When did you first learn that if you had
 117: 6 choked flow and then a shockwave caused by supersonic
 117: 7 flow, that you could get an, I guess, misleading
 117: 8 pressure differential as a flow parameter?
 117: 9 MS. STEVENSON: Object to the form and
 117: 10 vague.
 117: 11 THE WITNESS: I can't say that -- I know
 117: 12 that the first time we put statics down on the
 117: 13 diffuser was a Delta P/Delta P, and we didn't see any
 117: 14 problems with the shockwaves when we did it that way.

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117: 15 BY MR. LIND:
 117: 16 Q. When did you first learn of what we
 117: 17 talked about as the double solution problem?
 117: 18 A. I can't -- I don't know when I first knew
 117: 19 about that. I worked on the 131; we didn't have that
 117: 20 problem because we used a Delta P/Delta P. So I
 117: 21 couldn't say when I first learned of that.
 117: 22 Q. Well, you just said 131, did you mean the
 117: 23 131-3, specifically?
 117: 24 A. The 131-3.

140 117:25-118:3 Clark 12/06/2005

117: 25 Q. When did you -- well, when did you first
 118: 1 know of that fluid dynamics principles behind the
 118: 2 double solution problem; that's back in college,
 118: 3 right?

141 118:6-118:7 Clark 12/06/2005

118: 6 THE WITNESS: I knew of shockwaves and
 118: 7 pressure drops back then.

142 118:9-118:12 Clark 12/06/2005

118: 9 Q. And those are through the fluid dynamic
 118: 10 principles that you discussed that are responsible
 118: 11 for the double solution problem, correct?
 118: 12 A. That's correct.

143 118:23-119:6 Clark 12/06/2005

118: 23 Q. I really need you to focus on my
 118: 24 question. Can a shockwave occur anywhere in a
 118: 25 compressor other than the diffuser?
 119: 1 MS. STEVENSON: Objection; asked and
 119: 2 answered.
 119: 3 THE WITNESS: From what I know about
 119: 4 fluid mechanics and what I know a little about
 119: 5 compressors, the only place I know that the area
 119: 6 increases like that is in the diffuser.

144 119:21-120:6 Clark 12/06/2005

119: 21 Q. So the two places -- or the two ways in
 119: 22 which you say you get the double solution problem are
 119: 23 either where you get a shockwave between two static
 119: 24 pressure taps within the diffuser, that's one way,
 119: 25 right?
 120: 1 A. Yeah, that's one way.
 120: 2 Q. And the other way is where you have a
 120: 3 shockwave between a static pressure tap in the
 120: 4 diffuser and a total pressure tap outside the
 120: 5 discharging diffuser, correct?

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120: 6 A. That's another way.

145 **122:2-122:10** Clark 12/06/2005

122: 2 Q. If you operate a compressor continuously
 122: 3 close to surge, will you experience the double
 122: 4 solution problem?
 122: 5 MS. STEVENSON: Objection; vague and
 122: 6 incomplete hypothetical.
 122: 7 THE WITNESS: Close to surge you -- it
 122: 8 would be a very poorly designed compressor if there
 122: 9 was supersonic flow in there; I would not expect
 122: 10 that.

146 **127:3-127:8** Clark 12/06/2005

127: 3 Q. So any time that you take a static
 127: 4 pressure measurement in the context of a flow
 127: 5 parameter within the diffuser that experiences
 127: 6 supersonic flow, you're going to expect to see that
 127: 7 double solution curve, correct?
 127: 8 A. You could say that, yes.

147 **127:9-127:14** Clark 12/06/2005

127: 9 Q. When was the first time that you or
 127: 10 anyone else at Honeywell ever saw a double solution
 127: 11 curve?
 127: 12 A. I know I did not see that during the 131
 127: 13 program, so it was after that, that's as close as I
 127: 14 can -- the 131-3.

148 **128:23-129:1** Clark 12/06/2005

128: 23 Q. And you knew about shockwaves and their
 128: 24 effect on dropping discharge pressure when you
 128: 25 studied that in your fluid dynamics courses in
 129: 1 college, correct?

149 **129:4-129:6** Clark 12/06/2005

129: 4 THE WITNESS: We studied that, we didn't
 129: 5 necessarily study air sensors, though; there has to
 129: 6 be a relationship there and I don't believe --

150 **129:8-129:17** Clark 12/06/2005

129: 8 Q. You studied flow?
 129: 9 A. I studied flow, and I certainly didn't
 129: 10 pick it up.
 129: 11 Q. Pick what up?
 129: 12 A. The fact that putting static pressures
 129: 13 down there would cause this double solution problem.
 129: 14 Q. You didn't pick that up in your college
 129: 15 courses?

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129: 16 A. I didn't pick that up from my college
129: 17 courses that that would be a problem.

151 **130:1-130:7** Clark 12/06/2005

130: 1 Q. When did you first know about the double
130: 2 solution curve in the context of Honeywell's own
130: 3 surge control logic?
130: 4 A. I think I've asked (sic) that question
130: 5 before; I can't give you a -- I don't know an exact
130: 6 date on that, because the program I worked on didn't
130: 7 have that problem.

152 **130:15-131:3** Clark 12/06/2005

130: 15 Q. Early or late 1980s?
130: 16 A. I don't know. I couldn't say.
130: 17 Q. And what would you do to find out the
130: 18 first time that you or anyone else at Honeywell knew
130: 19 about the double solution problem?
130: 20 A. We could check and see -- I know that
130: 21 it's used in the 331-350; I could check to see memos
130: 22 on that.
130: 23 Q. When you say "it is used," what is the
130: 24 "it" you're referring to?
130: 25 A. There's logic in there to switch with
131: 1 this double solution problem.
131: 2 Q. Does that logic exist in the 331-200?
131: 3 A. No.

153 **131:16-131:19** Clark 12/06/2005

131: 16 Q. So the 331-350 looks at inlet guide vane
131: 17 position in order to recognize whether you're
131: 18 experiencing the double solution problem?
131: 19 A. That is correct.

154 **134:8-134:15** Clark 12/06/2005

134: 8 Q. Describe for me the logic in the 331-350
134: 9 that used inlet guide vane position to determine
134: 10 whether the double solution issue existed?
134: 11 A. Yeah, I think I already replied to that.
134: 12 There's a -- I believe there's a schedule in there,
134: 13 it's got inlet guide vane position and pressure
134: 14 inputs, and it makes a decision on which side of the
134: 15 curve you're on.

155 **134:24-135:7** Clark 12/06/2005

134: 24 Q. Why does the double solution problem
134: 25 occur in the 331-350?
135: 1 A. Because the static ports were put down in
135: 2 the diffuser.

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135: 3 Q. So any time you put static pressure ports
 135: 4 in the diffuser, you can exhibit -- and you get
 135: 5 supersonic flow in the diffuser, you'll experience
 135: 6 this double solution problem?
 135: 7 A. Yes, that's right.

156 **135:8-135:14** Clark 12/06/2005
 135: 8 Q. Where are the static ports in the
 135: 9 331-50-- I'm sorry, where are the static pressure
 135: 10 ports within the 331-350 diffuser?
 135: 11 A. I don't know where they are exactly,
 135: 12 they're down -- they're in the diffusers and I don't
 135: 13 know the location, that was -- if that was the
 135: 14 question.

157 **135:16-135:19** Clark 12/06/2005
 135: 16 And is -- when you're -- the 331-350 uses
 135: 17 your Delta P/P flow parameter in its surge control
 135: 18 system, correct?
 135: 19 A. That's correct.

158 **135:20-135:24** Clark 12/06/2005
 135: 20 Q. So my understanding of the Delta P/P
 135: 21 flow-related parameter is that it is total pressure
 135: 22 minus static pressure over total pressure, correct?
 135: 23 A. It's total pressure minus static
 135: 24 pressure, that quantity over total pressure.

159 **137:4-137:13** Clark 12/06/2005
 137: 4 Q. Is the difference between the control --
 137: 5 surge control logic to the 331-200 and the 331-350 be
 137: 6 the location of the static pressure taps, then?
 137: 7 A. That's correct.
 137: 8 Q. Why did you move the static pressure tap
 137: 9 from the duct in the 331-200 to the diffuser in the
 137: 10 331-350?
 137: 11 A. I don't know all the reasons, but I know
 137: 12 one reason was to get a larger Delta P signal, which
 137: 13 we previously discussed.

160 **138:14-138:18** Clark 12/06/2005
 138: 14 Q. Mr. Clark, does the 165-9 APU experience
 138: 15 the double solution problem?
 138: 16 A. The 165-9 doesn't have a load compressor.
 138: 17 Q. You mention that -- so the answer is no?
 138: 18 A. The answer is no.

161 **139:13-139:25** Clark 12/06/2005
 139: 13 Q. Can you have the double solution problem

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139: 14 in a compressor that is not a load compressor?
 139: 15 A. We don't have any diffuser statics in any
 139: 16 compressor that's not a load compressor.
 139: 17 Q. That's a different answer to a different
 139: 18 question. Here's my question, can you have the
 139: 19 double solution problem in a compressor that is not a
 139: 20 load compressor?
 139: 21 A. By design, I don't think you would.
 139: 22 Q. If that compressor had a diffuser, you
 139: 23 could have a double solution problem in a compressor
 139: 24 that is not a load compressor, correct?
 139: 25 MS. STEVENSON: Objection; argumentative

162 **140:1-140:12** Clark 12/06/2005

140: 1 and asked and answered.
 140: 2 THE WITNESS: If you don't have a load
 140: 3 compressor, it's usually a bleed machine. And bleed
 140: 4 machines take off a little bit of bleed flow, but
 140: 5 most of the -- it's an engine, and most of its flow
 140: 6 is going through its own turbine, okay, so if you put
 140: 7 the statics down in the diffuser to sense flow, you'd
 140: 8 see a very small change in flow, because most of the
 140: 9 flow is going through the turbine; that's why I said
 140: 10 by design you wouldn't have a double solution
 140: 11 problem, because you wouldn't put diffuser statics in
 140: 12 a machine that didn't have a load compressor.

163 **140:22-141:2** Clark 12/06/2005

140: 22 Q. I want to ask you some more questions
 140: 23 about Honeywell's use of inlet guide vane position to
 140: 24 solve the double solution problem, okay?
 140: 25 A. (No audible response.)
 141: 1 Q. Why did Honeywell use inlet guide vane
 141: 2 position to solve the double solution problem?

164 **141:4-141:7** Clark 12/06/2005

141: 4 THE WITNESS: I think -- I didn't work on
 141: 5 that, but I -- they looked for some logic to try and
 141: 6 find out when that occurs, and one of the parameters
 141: 7 that is an influence there is IGV position.

165 **141:9-141:15** Clark 12/06/2005

141: 9 Q. One of the reasons that you used IGV
 141: 10 position to solve the double solution problem is that
 141: 11 IGV position influences where you are on the
 141: 12 compressor map, right?
 141: 13 A. It changes the compressor map.
 141: 14 Q. So yes?

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141: 15 A. Yes, it changes the compressor map.

166 **141:16-141:18** Clark 12/06/2005

141: 16 Q. Who worked on Honeywell's development of
141: 17 the surge control system that used IGV position to
141: 18 solve the double solution problem?

167 **141:20-141:22** Clark 12/06/2005

141: 20 THE WITNESS: The first -- the first
141: 21 product that we had that had that was the 331-350,
141: 22 and I think I've already given that answer.

168 **144:20-145:1** Clark 12/06/2005

144: 20 Q. But because that happens, because change
144: 21 in IGV position changes the compressor operating
144: 22 curve, you have to use IGV position to solve the
144: 23 double solution problem, right?
144: 24 A. I don't know if they are the same,
144: 25 governed by the same principle, so I'm not -- I don't
145: 1 know if you would have -- that's a conclusion.

169 **150:21-150:25** Clark 12/06/2005

150: 21 Q. One of the things you need to know to
150: 22 know where that double solution problem exists is
150: 23 which IGV position you're on, because that will
150: 24 determine --
150: 25 A. That's part of the information you need.

170 **151:5-151:25** Clark 12/06/2005

151: 5 Q. You made a distinction between the
151: 6 controls engineer guy on the one hand --
151: 7 A. One guy does analysis.
151: 8 Q. Let me finish -- and the guy who I think
151: 9 you said designs the system on the other hand; what
151: 10 was the distinction you're trying to draw?
151: 11 A. One person is -- Harold Riley is in
151: 12 charge of the ECU; that's his responsibility. The
151: 13 ECU is electronic control unit, and he defines what
151: 14 goes on in there. He may not understand what goes in
151: 15 there, but he defines that to whoever vendor is
151: 16 making the control. The controls analysis guy can --
151: 17 because they -- Harold doesn't necessarily understand
151: 18 it, he can go to the controls analysis and ask him
151: 19 how should I control this. And so it's a controls
151: 20 analysis person to come up with this is the way you
151: 21 control it.
151: 22 Q. Who's the guy who knows all the Shapiro
151: 23 stuff about flows and thermodynamics and all that?
151: 24 A. It's supposed to be the analysis person.

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151: 25 Q. So one of the critical people in

171 **152:1-152:21** Clark 12/06/2005

152: 1 designing and understanding the surge control system
 152: 2 is the person who knows the thermodynamic and fluid
 152: 3 dynamic principles, and then another person might be
 152: 4 someone who actually is a control designer kind of
 152: 5 person?

152: 6 A. He's the person that writes the
 152: 7 specifications and is in charge of the ECU, making
 152: 8 sure it's purchased and comes in on schedule. He's a
 152: 9 hardware and software type person. He's the person
 152: 10 that describes the real specification; he doesn't
 152: 11 necessarily have to know how it works.

152: 12 Q. And that's the controls guy you're
 152: 13 talking about?

152: 14 A. That's the controls guy; that would be
 152: 15 the Harold Riley guy.

152: 16 Q. And then there's the other guy who is
 152: 17 important in this process who knows how it all works
 152: 18 in the sense that knows what the fluid dynamic
 152: 19 properties are and whatnot, correct?

152: 20 A. He's the guy who is supposed to know how
 152: 21 it works in the fluid properties.

172 **157:7-157:18** Clark 12/06/2005

157: 7 Q. Would the 331-200 also have the potential
 157: 8 for the double solution problem, if it didn't
 157: 9 experience it?

157: 10 A. It does not have diffuser statics, you
 157: 11 said 331-200, correct?

157: 12 Q. Correct.

157: 13 A. It would not have it because it does not
 157: 14 have diffuser statics.

157: 15 Q. When you say it does not have diffuser
 157: 16 statics, do you mean it does not have pressure taps
 157: 17 in the diffuser?

157: 18 A. That's correct.

173 **159:4-159:15** Clark 12/06/2005

159: 4 Q. Okay. When was the 131-9B surge control
 159: 5 logic developed?

159: 6 A. I couldn't tell you exactly.

159: 7 Q. Tell me --

159: 8 A. It was a -- I believe that thing was --
 159: 9 it had to have been after mid-'80s.

159: 10 Q. Can you tell me anything that changed in

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159: 11 the technology or the field of surge control between
 159: 12 the end of the 1970s and whenever the 331-350 surge
 159: 13 control logic was conceived that made the use of
 159: 14 inlet guide vane position to solve the double
 159: 15 solution problem unforeseeable back in the late '70s?

174 **160:2-160:9** Clark 12/06/2005

160: 2 Q. As Honeywell's corporate representative,
 160: 3 can you tell me anything that changed in the
 160: 4 technology in the field of surge control between the
 160: 5 end of the 1970s and whenever the 331-350 surge
 160: 6 control logic was conceived that made the use of
 160: 7 inlet guide vane position to solve the double
 160: 8 solution problem unforeseeable back in the late
 160: 9 1970s?

175 **160:12-160:13** Clark 12/06/2005

160: 12 THE WITNESS: I think I answered that
 160: 13 question, we didn't know that it existed.

176 **160:15-160:17** Clark 12/06/2005

160: 15 Q. Can you tell me anything --
 160: 16 A. So changing the technology wouldn't help,
 160: 17 we didn't know it existed.

177 **161:10-161:12** Clark 12/06/2005

161: 10 Q. Had you known that the double solution
 161: 11 problem existed in the late '70s, could you have
 161: 12 solved it?

178 **161:15-161:16** Clark 12/06/2005

161: 15 THE WITNESS: Well, we solved it on the
 161: 16 350, doing some tests there, because we ran into it.

179 **161:18-161:20** Clark 12/06/2005

161: 18 Q. Could you have done the same tests that
 161: 19 you did on the 350 to generate that data in the late
 161: 20 1970s?

180 **161:23-162:1** Clark 12/06/2005

161: 23 THE WITNESS: Well, the test data that
 161: 24 was done -- we didn't do this in that time frame, but
 161: 25 the -- the testing -- if the problem came up -- had
 162: 1 come up, it could have been solved.

181 **162:3-162:5** Clark 12/06/2005

162: 3 Q. In the late 1970s, had the double
 162: 4 solution problem come up, it could have been solved
 162: 5 at Honeywell?

182 **162:8-162:9** Clark 12/06/2005

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162: 8 THE WITNESS: If it had come up -- if it
 162: 9 had come up it could have been solved.

183 162:11-162:14 Clark 12/06/2005

162: 11 Q. And it could have been solved by using
 162: 12 inlet guide vane position, correct, in the late
 162: 13 1970s?
 162: 14 A. The same way we did it on the 350.

184 164:12-164:15 Clark 12/06/2005

164: 12 Q. I'm going show you Hamilton Remand
 164: 13 Exhibit 5, which is your declaration filed in this
 164: 14 case and signed by you on September 7th of the year
 164: 15 2000.

185 164:16-164:18 Clark 12/06/2005

164: 16 Is Exhibit 5 a signed copy of your sworn
 164: 17 declaration in this case?
 164: 18 A. It appears to be.

186 179:1-179:4 Clark 12/06/2005

179: 1 Q. I think that's the fourth sentence.
 179: 2 A. Okay. "To begin with, the use of the IGV
 179: 3 position performs the same function in the APS-3200
 179: 4 as it does in the patents."

187 183:18-184:3 Clark 12/06/2005

183: 18 Q. And then the last sentence, please look
 183: 19 at in that paragraph 10, you see that?
 183: 20 A. Okay.
 183: 21 Q. In the last sentence you say "So the fact
 183: 22 that Sunstrand's APS-3200 may have the inverted
 183: 23 V/double solution characteristic is irrelevant to the
 183: 24 question of whether the APS-3200 uses the technology
 183: 25 described in the 893 and 194 patents." And that was
 184: 1 and still is a true statement when you swore to it
 184: 2 under oath, correct?
 184: 3 A. That's correct.

188 185:6-185:22 Clark 12/06/2005

185: 6 Q. Right. And your point was that the issue
 185: 7 of using the inlet guide vane positions to solve that
 185: 8 hump problem or the double solution problem --
 185: 9 A. No, that wasn't the point --
 185: 10 Q. I'm sorry, sir, you have to let me
 185: 11 finish, otherwise you can't -- mind reading doesn't
 185: 12 quite work.
 185: 13 Your point was that the double solution
 185: 14 problem, I guess, quote, is irrelevant to the

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185: 15 question of whether the APS-3200 uses the technology
 185: 16 described in the patents, right?
 185: 17 A. That sentence means that the fact that
 185: 18 there is a hump there is irrelevant to the patent.
 185: 19 Q. And it's -- and the inverted double V
 185: 20 solution is irrelevant to determining whether there
 185: 21 is infringement of the patent, right?
 185: 22 A. I don't think that's what that's saying.

189 **187:19-188:5** Clark 12/06/2005

187: 19 Q. Are you saying that the fact that the APU
 187: 20 has this inverted V/double solution characteristic is
 187: 21 irrelevant to the question of whether the APS-3200 is
 187: 22 equivalent to the claims of the 893 and 194 patents?
 187: 23 A. I'm saying the inverted double V
 187: 24 solution, as you call it, means that that curve is
 187: 25 double valued, and I'm saying that characteristic is
 188: 1 irrelevant.
 188: 2 Q. And it's irrelevant to whether the
 188: 3 APS-3200 is equivalent to what is claimed in the 893
 188: 4 and 194 patents?
 188: 5 A. That's correct.

190 **189:11-189:14** Clark 12/06/2005

189: 11 Q. Uh-huh. You've stated that the 331-350
 189: 12 APU, for example, has the same inverted V or double
 189: 13 solution problem as the APS-3200, correct?
 189: 14 A. Right.

191 **192:10-192:15** Clark 12/06/2005

192: 10 Q. Now, in the second sentence, Mr. Muller
 192: 11 says, "But that inverted V/double solution
 192: 12 characteristic has more to do with where pressure is
 192: 13 being measured in the compressor than how the
 192: 14 APS-3200 controls surge"; do you see that?
 192: 15 A. I see it.

192 **193:3-193:22** Clark 12/06/2005

193: 3 Q. First, I just asked if you agreed with
 193: 4 that statement.
 193: 5 A. Well, I'm explaining. He's just saying
 193: 6 that the double valued curve characteristic is just
 193: 7 where you put the static hole in the diffuser.
 193: 8 Q. As opposed to having to do with how the
 193: 9 compressor or how the APS-3200 controls surge?
 193: 10 A. He's saying that how it controls surge
 193: 11 does not cause that double V solution, the double
 193: 12 valued curve.

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193: 13 Q. And do you agree with the proposition
 193: 14 that the inverted double V characteristic has more to
 193: 15 do with where the pressure is being measured in the
 193: 16 compressor than how the APS-3200 controls surge?
 193: 17 A. As I've explained I agree with it, but my
 193: 18 interpretation of what he is saying is that
 193: 19 multi-valued function is caused solely by where you
 193: 20 put the static flow.
 193: 21 Q. Did you talk to Mr. Muller about that
 193: 22 sentence?

193 **194:2-194:3** Clark 12/06/2005
 194: 2 THE WITNESS: I believe I have stated
 194: 3 that I don't know Mr. Muller.

194 **194:10-194:10** Clark 12/06/2005
 194: 10 Q. Is this common?

195 **194:11-194:16** Clark 12/06/2005
 194: 11 MS. STEVENSON: Object to the form, and
 194: 12 vague.
 194: 13 THE WITNESS: Some -- well -- can you
 194: 14 define what you mean by "common," they all -- every
 194: 15 load compressor that gets a certain pressure has that
 194: 16 phenomenon.

196 **194:18-194:20** Clark 12/06/2005
 194: 18 Q. Do you agree with Mr. Muller's statements
 194: 19 that "Load compressors utilized in APUs commonly
 194: 20 produce supersonic conditions in the diffuser"?

197 **194:23-194:25** Clark 12/06/2005
 194: 23 THE WITNESS: I'm having trouble with the
 194: 24 word "common," does that mean in operation, I don't
 194: 25 know.

198 **195:2-195:10** Clark 12/06/2005
 195: 2 Q. You don't know what Mr. Muller meant
 195: 3 there?
 195: 4 A. It's going to be there, whether you see
 195: 5 it in operation, I don't know. You don't always see
 195: 6 it in operation, but it's going to be there.
 195: 7 Q. When you say "it," you mean supersonic
 195: 8 conditions?
 195: 9 A. The supersonic condition. It is
 195: 10 physically possible to get the supersonic condition.

199 **196:23-197:10** Clark 12/06/2005
 196: 23 Q. We talked a little bit about the
 196: 24 shockwaves and flow and supersonic flow earlier

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196: 25 today, right?
 197: 1 A. That's correct.
 197: 2 Q. And Mr. Muller discusses that and I want
 197: 3 to see if you -- your understanding is consistent
 197: 4 with his, okay?
 197: 5 A. Correct.
 197: 6 Q. He says that a shockwave produces almost
 197: 7 instantaneous pressure changes, do you agree with
 197: 8 that?
 197: 9 A. Yes, it happens over a very narrow
 197: 10 region.

200 **198:7-198:11** Clark 12/06/2005

198: 7 Q. When you have a shockwave, does that
 198: 8 cause a jump in pressure downstream of the diffuser?
 198: 9 A. When you have a -- when you have a
 198: 10 shockwave, you lose the stagnation or the total
 198: 11 pressure across the shockwave.

201 **198:20-199:7** Clark 12/06/2005

198: 20 Q. Turn the page, same paragraph halfway
 198: 21 down, page 13.
 198: 22 A. I'm on 13.
 198: 23 Q. All right. The -- halfway down the
 198: 24 paragraph it says "The existence of the inverted
 198: 25 V/double solution characteristic in the APS-3200,
 199: 1 therefore, has nothing to do with whether or not the
 199: 2 APS-3200 uses the technology in the 893 and 194
 199: 3 patents." Do you agree with that?
 199: 4 A. Well, I -- I agree with the next sentence
 199: 5 in conjunction with that, where it says "The double V
 199: 6 solution characteristic is strictly the result of the
 199: 7 location of the static pressure tap."

202 **199:8-199:13** Clark 12/06/2005

199: 8 Q. Do you agree with the following sentence
 199: 9 that says "Any compressor taking the static
 199: 10 measurement of supersonic air flow in the diffuser
 199: 11 would have a similar, that is, double solution
 199: 12 characteristic"?
 199: 13 A. I agree with that.

203 **202:19-203:2** Clark 12/06/2005

202: 19 Q. You talked about the APU called the 131-3
 202: 20 earlier today, right?
 202: 21 A. Right.
 202: 22 Q. And that's the one that uses your
 202: 23 Delta P/Delta P surge control system, correct?

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202: 24 A. That's correct.
 202: 25 Q. And does the 131-3 experience the
 203: 1 potential for the double solution characteristic?
 203: 2 A. It does not have that characteristic.

204 **204:18-204:24** Clark 12/06/2005
 204: 18 Q. When you measure static pressure at the
 204: 19 far end of the diffuser, is that essentially the same
 204: 20 as measuring total pressure?
 204: 21 A. It's much closer to total pressure.
 204: 22 Q. And the closer you go to the very end of
 204: 23 the diffuser discharge --
 204: 24 A. The closer it gets to total pressure.

205 **205:16-205:21** Clark 12/06/2005
 205: 16 Q. Yeah, in the 131-3, because you have two
 205: 17 static pressure sensors in the diffuser, doesn't the
 205: 18 potential for the double solution problem exist?
 205: 19 A. I don't believe so. As I explained
 205: 20 later, the signal does not turn around and go back,
 205: 21 it's not double valued as in the double V solution.

206 **205:25-205:25** Clark 12/06/2005
 205: 25 Q. At least you haven't experienced the peak

207 **206:1-206:3** Clark 12/06/2005
 206: 1 of the double V curve based on the data that
 206: 2 Honeywell's collected on the 131-3?
 206: 3 A. That's correct.

208 **217:4-217:21** Clark 12/06/2005
 217: 4 Q. When was the GPG application?
 217: 5 A. I don't remember.
 217: 6 Q. So the first time that you remember
 217: 7 testing APUs, including measuring the static --
 217: 8 differences in static pressure within the diffuser
 217: 9 was the GPG application?
 217: 10 A. I don't swear by that GPG acronym, but
 217: 11 whatever that was, it was, I believe, a ground cart.
 217: 12 Q. In the 331-200 APU, when Honeywell tested
 217: 13 that APU on its test stand, did it measure -- in the
 217: 14 development of that APU, did it measure static
 217: 15 pressure in the diffuser?
 217: 16 A. In the engine?
 217: 17 Q. Yes.
 217: 18 A. With the engine, no.
 217: 19 Q. No, on the test rig?
 217: 20 A. Just the compressor by itself, I can't
 217: 21 say for sure they did, my -- it's standard practice.

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209	218:5-218:14	Clark 12/06/2005
	218: 5	Q. And is it also standard practice when
	218: 6	you're testing a compressor on the test rig to look
	218: 7	at differences in static pressure along the diffuser?
	218: 8	A. I don't know what they do with the data.
	218: 9	That's compressor people's data, that's their test
	218: 10	rig, it's not a -- it's not run for controls
	218: 11	purposes.
	218: 12	Q. Well, that data from the compressor
	218: 13	testing is data that makes its way to you, at least
	218: 14	in the sense of the compressor maps, right?
210	218:15-218:15	Clark 12/06/2005
	218: 15	MS. STEVENSON: Objection; argumentative.
211	218:16-218:24	Clark 12/06/2005
	218: 16	THE WITNESS: Not all that data, no. The
	218: 17	only data we get would be, if the compressor map
	218: 18	doesn't have that data, the compressor map shows the
	218: 19	pressure ratio and the flow.
	218: 20	BY MR. LIND:
	218: 21	Q. What do you mean by "that data" when you
	218: 22	said "that data"?
	218: 23	A. That data would be those pressures in the
	218: 24	diffuser.
212	219:10-219:21	Clark 12/06/2005
	219: 10	Q. Where are the test stands where the
	219: 11	Honeywell runs the compressor tests?
	219: 12	A. Where are they physically?
	219: 13	Q. Yes.
	219: 14	A. They're in the plant, they're in the
	219: 15	Phoenix plant there.
	219: 16	Q. Who is in charge of running the
	219: 17	compressor test stand tests?
	219: 18	A. There's a group that designs our
	219: 19	compressors; they would be in charge, I assume that's
	219: 20	who you mean, not the actual technicians, but the
	219: 21	person in charge of the test plan and the test.
213	220:1-220:6	Clark 12/06/2005
	220: 1	Q. What's the group called?
	220: 2	A. It used to be called Aerodynamics, they
	220: 3	may have changed their name.
	220: 4	Q. What was the group that tests compressors
	220: 5	called when you joined Honeywell in the late 1970s?
	220: 6	A. I believe they were called Aerodynamics.

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214	220:10-220:14	Clark 12/06/2005 220: 10 Q. Am I right that you have been involved in 220: 11 developing surge control systems for going on 30 220: 12 years? 220: 13 A. Not 30 years, a little short than 30 220: 14 years.
<hr/>		
215	222:6-222:12	Clark 12/06/2005 222: 6 Q. How long after the customer gives you the 222: 7 flow requirements for the compressor, how long after 222: 8 that do you generally conceive of how the surge 222: 9 control system might work? 222: 10 MS. STEVENSON: Objection; vague. 222: 11 THE WITNESS: I couldn't give you an 222: 12 average answer on that.
<hr/>		
216	222:25-223:4	Clark 12/06/2005 222: 25 Q. So it might take up to two years between 223: 1 getting the customer's flow requirements for the 223: 2 compressor it wants to just even coming up with an 223: 3 idea of how you're going to give that customer that 223: 4 flow requirement without surging?
<hr/>		
217	223:6-223:6	Clark 12/06/2005 223: 6 THE WITNESS: Approximately.
<hr/>		
218	227:15-227:20	Clark 12/06/2005 227: 15 Q. Are you involved in drafting the PSCs for 227: 16 surge control systems? 227: 17 A. I think I talked earlier about Harold 227: 18 Riley and what part he is, he is the writer of the 227: 19 PSC. He can come to me and ask me to describe 227: 20 portions of what should go in there.
<hr/>		
219	241:12-241:25	Clark 12/06/2005 241: 12 Q. And generally, about how long does the 241: 13 process take between the time that you start looking 241: 14 at what type of control logic for surge control you 241: 15 might use and the developmental testing? 241: 16 A. I don't know, it varies. 241: 17 Q. What does it vary between, about? 241: 18 MS. STEVENSON: Objection; calls for 241: 19 speculation. 241: 20 THE WITNESS: Off the top of my head, I 241: 21 couldn't say. 241: 22 BY MR. LIND: 241: 23 Q. Could it be more than a year between the 241: 24 time you start looking at what type of control logic

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		241: 25	you might use and the completion of the developmental
220	242:1-242:17	Clark 12/06/2005	
		242: 1	testing?
		242: 2	MS. STEVENSON: Calls for speculation.
		242: 3	THE WITNESS: It varies, and I
		242: 4	couldn't -- I couldn't say. Certainly a year is on
		242: 5	the order of time frame.
		242: 6	BY MR. LIND:
		242: 7	Q. And has that process and that timing been
		242: 8	generally the same throughout your career at
		242: 9	Honeywell?
		242: 10	A. The -- no. No, I don't believe that's
		242: 11	been the same.
		242: 12	Q. How has it been different, if at all, and
		242: 13	when?
		242: 14	MS. STEVENSON: Object to the form.
		242: 15	THE WITNESS: I believe with the use of
		242: 16	more modern tools, that computer analysis has
		242: 17	somewhat helped to speed us up some.
221	242:25-243:7	Clark 12/06/2005	
		242: 25	Q. But what you're saying is that back in
		243: 1	the late '70s, between, let's say, when you started
		243: 2	looking at what type of control logic you would use
		243: 3	and the completion of developmental testing might
		243: 4	have actually been longer because you didn't have
		243: 5	computers and the newfangled stuff that we have
		243: 6	today; is that right?
		243: 7	A. I think it took a longer time then.
222	245:23-245:25	Clark 12/06/2005	
		245: 23	Q. Is the document on page 899 the kind of
		245: 24	more detailed design document or schematic drawing
		245: 25	that you might -- that you would come up with as part
223	246:1-246:6	Clark 12/06/2005	
		246: 1	of designing a surge control system?
		246: 2	A. This is a pneumatic schematic of the
		246: 3	surge valve.
		246: 4	Q. And who wrote the text on page 899?
		246: 5	A. I don't know who wrote the text. I did
		246: 6	not write the text.
224	246:17-247:2	Clark 12/06/2005	
		246: 17	Q. Did the surge control system on the
		246: 18	F-18's APU control surge by looking at Delta P/P?
		246: 19	A. That's correct.
		246: 20	Q. And that was a surge control -- that was

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246: 21 the flow parameter used by the surge control system,
 246: 22 correct?
 246: 23 A. That's correct.
 246: 24 Q. And that flow parameter of Delta P/P was
 246: 25 used by Honeywell back in at least March of 1978,
 247: 1 correct?
 247: 2 A. Correct.

225 **249:20-249:24** Clark 12/06/2005
 249: 20 Q. You knew in June of 1978 that using
 249: 21 adjustable inlet guide vanes in the load compressor
 249: 22 would affect the surge valve logic because the surge
 249: 23 line moves with each IGV angle, correct?
 249: 24 A. Yeah, the date on this is June 9th, 1978.

226 **250:5-250:10** Clark 12/06/2005
 250: 5 Q. Did you know as of June of 1978 that
 250: 6 using adjustable inlet guide vanes in a load
 250: 7 compressor would affect the surge valve logic because
 250: 8 the surge line moves with each different inlet guide
 250: 9 vane position?
 250: 10 A. We knew that.

227 **253:14-253:22** Clark 12/06/2005
 253: 14 Q. And when you're looking at ideas on how
 253: 15 to control surge, you can do that either
 253: 16 electronically or pneumatically, correct?
 253: 17 A. That's correct.
 253: 18 Q. And you can have equal effectiveness with
 253: 19 pneumatic or electronic control, correct?
 253: 20 MS. STEVENSON: Object to the form,
 253: 21 vague.
 253: 22 THE WITNESS: That's not true.

228 **254:1-254:22** Clark 12/06/2005
 254: 1 Q. When you say "pneumatic surge control,"
 254: 2 is that another way of saying mechanical surge
 254: 3 control, as opposed to electronic?
 254: 4 A. A pneumatic would be like the schematic
 254: 5 in this document.
 254: 6 Q. But are pneumatic surge control systems
 254: 7 mechanical, as opposed to electronic?
 254: 8 A. They have spring -- I don't know what
 254: 9 your question is. Mechanical, there's pneumatic
 254: 10 mechanical, and part of the control is pneumatic
 254: 11 there's a Delta P on the diaphragm.
 254: 12 Q. Is a pneumatic surge control system a
 254: 13 mechanically operated surge control system?

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254: 14 A. I'm sorry, I don't -- I -- can you
 254: 15 rephrase the question?
 254: 16 Q. I don't think so. I'll move on.
 254: 17 What does "pneumatic" mean?
 254: 18 A. Pneumatic is -- a pneumatic valve is a
 254: 19 valve that only air goes in, okay; it doesn't have
 254: 20 any hydraulic or incompressible fluid in it.
 254: 21 Q. Does it have any electronic controls?
 254: 22 A. It doesn't have any electronic controls.

229 **255:25-256:8** Clark 12/06/2005

255: 25 Q. Sure. As one of the initial parts of
 256: 1 developing a surge control system, you're going to
 256: 2 look at the compressor maps for that compressor,
 256: 3 correct?
 256: 4 A. Compressor maps are used.
 256: 5 Q. You have a passive voice issue I call
 256: 6 this. As one of the initial parts of developing a
 256: 7 surge control system you're going to look at the
 256: 8 compressor maps for that compressor, correct?

230 **256:11-256:12** Clark 12/06/2005

256: 11 THE WITNESS: Part of the design of the
 256: 12 surge control system involves using compressor maps.

231 **256:18-256:20** Clark 12/06/2005

256: 18 THE WITNESS: We discussed previously,
 256: 19 the initial designs usually sizing components and
 256: 20 that -- for that you need compressor maps.

232 **256:22-256:24** Clark 12/06/2005

256: 22 Q. Can you design a surge control system
 256: 23 without knowing what the compressor map looks like?
 256: 24 A. I think so.

233 **256:25-257:5** Clark 12/06/2005

256: 25 Q. As a practice and an engineer like
 257: 1 yourself, does it make common sense to know what the
 257: 2 compressor map looks like before you design the surge
 257: 3 control system for that particular compressor?
 257: 4 A. That would be a -- that would be
 257: 5 something that you would want a compressor map.

234 **258:7-258:14** Clark 12/06/2005

258: 7 Q. And your compressor maps in your June
 258: 8 1978 memo again show that you have different
 258: 9 operating lines for different inlet guide vane
 258: 10 positions, correct?
 258: 11 A. There are lines plotted on this

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258: 12 compressor map; I do not know if those are what we
 258: 13 call the surge control line or if that's what's
 258: 14 called the operating line.

235 **265:9-265:16** Clark 12/06/2005

265: 9 Q. We're almost done for the day. The F-18
 265: 10 did not use -- did not adjust the set point based on
 265: 11 inlet guide vane position, correct?
 265: 12 A. That's correct.
 265: 13 Q. Did you consider in developing the surge
 265: 14 control system for the F-18, using inlet guide vane
 265: 15 position to adjust the set point?
 265: 16 A. I don't believe that was considered.

236 **271:11-271:25** Clark 12/06/2005

271: 11 Q. Why were you looking at where choke
 271: 12 occurred with respect -- in Exhibit 9 with respect to
 271: 13 the 331-200?
 271: 14 A. I believe I'm doing a simulation here.
 271: 15 and I'm trying to write an equation for that line,
 271: 16 and I think I put in something like an ellipse, a
 271: 17 partial -- part of an ellipse for that equation, so
 271: 18 the choke flow would be the highest part on the
 271: 19 ellipse, I'm trying to curve at that line.
 271: 20 Q. Other than plotting the IGV lines or
 271: 21 drawing equations for the IGV lines, was there any
 271: 22 other reason in 1978, '79 you were interested in
 271: 23 determining when choke occurred?
 271: 24 A. I don't believe so.
 271: 25 Q. Not that you recall today?

237 **272:1-272:7** Clark 12/06/2005

272: 1 A. I would say there is no other reason,
 272: 2 other than trying to develop an equation for that
 272: 3 line.
 272: 4 Q. Do you know of any other reasons that
 272: 5 others at Honeywell looked at choke in the late '70s
 272: 6 and when choke occurred?
 272: 7 A. No, I don't.

238 **284:11-284:11** Clark 12/07/2005

284: 11 (Exhibit 10 was marked for identification.)

239 **285:2-285:8** Clark 12/07/2005

285: 2 Q. By July of 1979, the 331-200 surge
 285: 3 control system had an electronic system that used
 285: 4 inlet guide vane position as an input into the surge
 285: 5 control system, correct?
 285: 6 A. That's shown in one of the figures.

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285: 7 Q. So is that, yes, that's correct?

285: 8 A. That's yes.

240 **285:20-286:11** Clark 12/07/2005

285: 20 Q. And if you turn the page in Exhibit 10 to

285: 21 page 72, is that a schematic of the surge control

285: 22 system on the 331-200 as of July of 1979?

285: 23 A. That's a schematic of the -- as of this

285: 24 PDR, yes.

285: 25 Q. And it also has in the bottom right-hand

286: 1 corner a box indicating the surge control logic,

286: 2 correct?

286: 3 A. That's correct. I believe that box

286: 4 represents the electronic control logic.

286: 5 Q. And that indicates, doesn't it, that

286: 6 there's a flow parameter that is driven by inlet

286: 7 guide vane position?

286: 8 A. Yes, it has listed a P -- the box -- By

286: 9 the box there's an equation that says, "P total minus

286: 10 P static divided by P total is equal to a function of

286: 11 IGV angle."

241 **287:9-287:21** Clark 12/07/2005

287: 9 Q. Turn to page 77. Is this figure the

287: 10 diagram of the surge valve control logic for the

287: 11 331-200?

287: 12 A. As it was in 1979.

287: 13 Q. In the bottom left-hand corner, does that

287: 14 indicate that there was a schedule of inlet guide

287: 15 vane position and minimum flow requirements?

287: 16 A. That is the schedule as a function of IGV

287: 17 angle of the Delta P/P that the surge valves control

287: 18 had.

287: 19 Q. And Delta P/P is the flow related

287: 20 parameter, correct?

287: 21 A. Correct.

242 **289:22-290:1** Clark 12/07/2005

289: 22 Q. Okay. If you look at page 41, there are

289: 23 two flow sensors. One is a pitot tube through the

289: 24 middle of the opening and the other is a static ring,

289: 25 static pressure sensor; is that correct?

290: 1 A. That's correct.

243 **291:8-291:12** Clark 12/07/2005

291: 8 Q. And does that indicate that in 1979,

291: 9 Honeywell was looking at the fact that there are

291: 10 different surge points for different inlet guide vane

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291: 11 positions?
291: 12 A. We knew that in 1979.

244 291:18-293:18 Clark 12/07/2005

291: 18 Q. Turn the page to the page ending in 765.
291: 19 The graph titled, "Requirements For Reset With IGV
291: 20 Position."
291: 21 Do you see that?
291: 22 A. That's correct.
291: 23 Q. Do you recognize the graph on page 765 of
291: 24 Exhibit 12?
291: 25 A. It's a familiar graph.
292: 1 Q. Is that essentially the same graph that's
292: 2 in the patents that Honeywell's asserting against
292: 3 Sundstrand in this case?
292: 4 MS. STEVENSON: Object to the form.
292: 5 THE WITNESS: I can't remember the
292: 6 graphs.
292: 7 MS. STEVENSON: Lacks foundation.
292: 8 (Exhibit 13 was marked for identification.)
292: 9 Q. BY MR. LIND: Let me show you Hamilton
292: 10 Remand Exhibit 13. That's the '194 patent that
292: 11 Honeywell's asserting against Sundstrand in this
292: 12 case, correct?
292: 13 A. I believe there's two patents, correct?
292: 14 Q. But that's one of them?
292: 15 A. This is one.
292: 16 Q. Could you turn to figure 6, please. Is
292: 17 this figure 6 in the '194 patent essentially the same
292: 18 graph as the figure on page 765 of Exhibit 12?
292: 19 MS. STEVENSON: Object to the form.
292: 20 Vague.
292: 21 THE WITNESS: It shows -- Both curves
292: 22 show changing in surge line with different IGV
292: 23 angles.
292: 24 Q. BY MR. LIND: Aren't they essentially the
292: 25 same graphs?
293: 1 MS. STEVENSON: Objection. Asked and
293: 2 answered. And object to form. Vague.
293: 3 THE WITNESS: There's some information on
293: 4 one graph that's not on the other, I believe, but ...
293: 5 Q. BY MR. LIND: So if on page 765 of
293: 6 Exhibit 12 if you deleted the series of curves
293: 7 relating to the negative 8 degree inlet guide vane
293: 8 position, wouldn't that figure and figure 6 of the
293: 9 '194 patent essentially be the same?

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293: 10 MS. STEVENSON: Object the form. Vague.
 293: 11 THE WITNESS: There's a line on here that
 293: 12 says, "Delta P/P equals constant." I don't see that
 293: 13 on figure 6.
 293: 14 Q. BY MR. LIND: If you deleted from page
 293: 15 765 the Delta P/P equals constant dotted line and the
 293: 16 negative eight degree IGv series of lines, wouldn't
 293: 17 that figure be essentially the same as figure 6 of
 293: 18 the '194 patent?

245 **293:20-294:22** Clark 12/07/2005

293: 20 THE WITNESS: Figure 6 also doesn't plot
 293: 21 these performance points. At least I don't see them.
 293: 22 Q. BY MR. LIND: Where it says, "Typical
 293: 23 operating points"?
 293: 24 A. Yes.
 293: 25 Q. Well, it does, right, but it's got a line
 294: 1 instead of a point; isn't that right?
 294: 2 A. Does it label it? There is a line
 294: 3 labeled 160.
 294: 4 Q. I think that's the one that goes through
 294: 5 the middle. Don't you mean the line labeled 156?
 294: 6 MS. STEVENSON: Objection.
 294: 7 Argumentative.
 294: 8 THE WITNESS: Sorry. It's spelled out
 294: 9 someplace.
 294: 10 Q. BY MR. LIND: Sure. I'll find it for
 294: 11 you.
 294: 12 If you look at column 8 of the '194
 294: 13 patent, at line 62 or 63.
 294: 14 A. Okay.
 294: 15 Q. It calls lines 156 "One of the demand
 294: 16 line pairs."
 294: 17 Do you see that?
 294: 18 A. I'm sorry. I'm still looking.
 294: 19 MS. STEVENSON: Object to the form.
 294: 20 THE WITNESS: I see 158 and 160 extends
 294: 21 between and is essentially parallel to a different
 294: 22 one of the surge control demand line.

246 **294:23-295:3** Clark 12/07/2005

294: 23 Q. BY MR. LIND: Let me put it this way, Mr.
 294: 24 Clark. In addition to having some additional data,
 294: 25 not shown in figure 6 of the '194 patent, are the
 295: 1 figures shown at page 765 of Exhibit 12 in figure 6
 295: 2 of the '194 patent showing essentially the same
 295: 3 thing?

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247 **295:5-295:7** Clark 12/07/2005
 295: 5 THE WITNESS: They are the same thing in
 295: 6 that they show sets of IGV angles in different surge
 295: 7 lines.

248 **306:20-306:20** Clark 12/07/2005
 306: 20 (Exhibit 15 was marked for identification.)

249 **307:23-308:1** Clark 12/07/2005
 307: 23 Q. Does Exhibit 15, from March of 1980, show
 307: 24 that you were looking at using inlet guide vane angle
 307: 25 as an input into the surge control system?
 308: 1 A. I can't see that from this diagram.

250 **308:8-308:11** Clark 12/07/2005
 308: 8 Q. So does Exhibit 15, in March of 1980,
 308: 9 show that Honeywell was using inlet guide vane
 308: 10 position as an input into the surge control system?
 308: 11 A. That's correct.

251 **310:4-310:11** Clark 12/07/2005
 310: 4 Q. In March of 1980 in Honeywell's surge
 310: 5 control system, Honeywell used inlet guide vane
 310: 6 position to set the set points, correct?
 310: 7 A. That's correct.
 310: 8 Q. And the set points are used to determine
 310: 9 whether the flow is high enough that it may cause
 310: 10 surge, correct?
 310: 11 A. That's correct.

252 **310:12-310:24** Clark 12/07/2005
 310: 12 Q. And if the actual flow is higher than the
 310: 13 set point, then the surge bleed valve opens; is that
 310: 14 correct?
 310: 15 A. I think we've got it backwards. I used
 310: 16 the word high. That may have been inverted. If the
 310: 17 flow goes low, you want to open up the surge valve.
 310: 18 Q. If the actual flow is lower than the set
 310: 19 point, then the surge bleed valve opens, correct?
 310: 20 A. That's correct.
 310: 21 Q. And the set points are used to determine
 310: 22 whether the flow is low enough that it may cause
 310: 23 surge, correct?
 310: 24 A. Set points are used to determine that.

253 **315:7-315:17** Clark 12/07/2005
 315: 7 Q. But from the late '70s, you've known
 315: 8 about the fact you could measure static pressure,
 315: 9 correct?

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315: 10 MS. STEVENSON: Objection. Vague.
 315: 11 THE WITNESS: Your question just said you
 315: 12 can measure static pressure.
 315: 13 Q. BY MR. LIND: Right.
 315: 14 A. You can measure -- You're not saying,
 315: 15 "Do what?" You can measure static pressure.
 315: 16 Q. You've known since the 1970s that you can
 315: 17 measure static pressure in a compressor?

254 **315:20-315:24** Clark 12/07/2005
 315: 20 THE WITNESS: You're not stating what
 315: 21 for, so you can measure static pressure.
 315: 22 Q. BY MR. LIND: Have you known since the
 315: 23 1970s that you can measure static pressure in a
 315: 24 compressor?

255 **316:1-316:3** Clark 12/07/2005
 316: 1 THE WITNESS: The question's been
 316: 2 answered.
 316: 3 Q. BY MR. LIND: No, it hasn't, sir.

256 **317:9-317:14** Clark 12/07/2005
 317: 9 Have you known since the late 1970s that
 317: 10 you can measure total pressure in a compressor.
 317: 11 A. Since I've been working at Honeywell I've
 317: 12 known that.
 317: 13 Q. And same with static pressure, correct?
 317: 14 A. Same with static pressure.

257 **319:2-319:4** Clark 12/07/2005
 319: 2 Exhibit 17 is an April 17th, 1980, memo
 319: 3 that you wrote to the file, correct?
 319: 4 A. That's correct.

258 **320:7-321:7** Clark 12/07/2005
 320: 7 Q. If you just read the introduction and
 320: 8 tell me generally what this memo is about.
 320: 9 MS. STEVENSON: You should read as much
 320: 10 as you need to, Mr. Clark, to answer the question.
 320: 11 MR. LIND: Sure.
 320: 12 THE WITNESS: This is addressing some
 320: 13 problems we had. We put offices to the -- when you
 320: 14 measure pressure signals coming out of the
 320: 15 compressor, it's -- they fluctuate due to turbulence,
 320: 16 whatever. I don't know for sure, but there's -- it's
 320: 17 not just a nice, solid value. It fluctuates through
 320: 18 to some things.
 320: 19 When you're trying to measure two
 320: 20 pressures close together like a Delta P, you have to

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320: 21 get rid of some of that fluctuation, so we put
 320: 22 orifices in the line. When you put orifices in the
 320: 23 lines, it caused under -- I don't know what. It
 320: 24 caused some spikes in this -- in the delta P
 320: 25 transducer and failed the transducer.
 321: 1 Q. BY MR. LIND: Does Exhibit 17 refer to
 321: 2 any changes in where Honeywell was measuring
 321: 3 pressure?
 321: 4 A. It says, "In addition the flow sensor
 321: 5 tests were also run on a new static ring
 321: 6 configuration," so I can't completely answer your
 321: 7 question there. I don't remember this memo totally.

259 **321:9-321:16** Clark 12/07/2005
 321: 9 Does the graph on page 810, again, show
 321: 10 that in April of 1980, Honeywell was using inlet
 321: 11 guide vane position as an input in its surge control
 321: 12 system?
 321: 13 A. That is a schedule of the Delta P/P set
 321: 14 point for the surge system versus IGV angle.
 321: 15 Q. Is that a yes?
 321: 16 A. So that is showing that, what you said.

260 **321:25-322:5** Clark 12/07/2005
 321: 25 Q. BY MR. LIND: Mr. Clark, I'm going to
 322: 1 hand you what's been marked as Hamilton Remand
 322: 2 Exhibit 18, which is a January 28th, 1981, memo from
 322: 3 Mr. Stokes regarding the GTC 36-200 surge control
 322: 4 system, and it shows it was copied to you.
 322: 5 A. I'm on the copy list.

261 **322:13-322:20** Clark 12/07/2005
 322: 13 Q. And is that an accurate statement that as
 322: 14 of 1981, Honeywell knew that the compressor map
 322: 15 changes when IGV positions change?
 322: 16 A. I'd like to look at Figure 1.
 322: 17 Q. Okay.
 322: 18 A. Okay. Figure 1 does show that -- Let's
 322: 19 see. Figure 1 does show that the compressor map
 322: 20 changes when IGV positions change.

262 **323:6-323:8** Clark 12/07/2005
 323: 6 Q. Did you have any role in preparing
 323: 7 Exhibit 18, the January 1981 memo?
 323: 8 A. I can't remember.

263 **324:4-324:21** Clark 12/07/2005
 324: 4 Q. On Figure 1 in the right-hand corner it,
 324: 5 again, has our friend P sub T minus P sub S that

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324: 6 divided by P sub T.
 324: 7 Do you see that?
 324: 8 A. Yes.
 324: 9 Q. Is that what you've called the Delta P/P
 324: 10 flow parameter?
 324: 11 A. That's the Delta P/P flow parameter.
 324: 12 Q. Does Exhibit 18 show that with the 36-200
 324: 13 APU, just like the 331 APUs, Honeywell used inlet
 324: 14 guide vane position as an input in the surge control
 324: 15 system in -- as of 1981?
 324: 16 A. No, it does not show that. We did not
 324: 17 use on F-8 -- On F-18, we did not use the guide vane
 324: 18 position as an input to the surge control system.
 324: 19 Q. Because that was the pneumatic one,
 324: 20 right?
 324: 21 A. That was fully pneumatic.

264 **324:25-325:10** Clark 12/07/2005

324: 25 Q. If you weren't going to adjust the surge
 325: 1 control system based on inlet guide vane position,
 325: 2 why did you look, in 1981, at the F-18's load
 325: 3 compressor maps?
 325: 4 A. It does have IGV position. And you still
 325: 5 want to have that surge control line that's labeled
 325: 6 in Figure 1 of page 115 where the surge valve's going
 325: 7 to control. You still want to have that between --
 325: 8 and it's got MAS operating points -- you still want
 325: 9 that to run between the surge line and the
 325: 10 performance point.

265 **326:6-326:7** Clark 12/07/2005

326: 6 MS. STEVENSON: Object to the form.
 326: 7 Asked and answered.

266 **327:6-327:14** Clark 12/07/2005

327: 6 Q. BY MR. LIND: I'm going to hand you the
 327: 7 next exhibit which is Exhibit 19. Exhibit 19 is a
 327: 8 document dated December 2nd, 1981, called "The
 327: 9 Technical Description of the Electronic Control Unit
 327: 10 for the GTCP 331-200 Auxiliary Power Unit."
 327: 11 Do you have that before you?
 327: 12 A. I have that before me.
 327: 13 Q. And are you familiar with this document?
 327: 14 A. I'm not -- I'm not real -- I'd say no.

267 **329:17-329:21** Clark 12/07/2005

329: 17 Q. The inlet guide vane position will affect
 329: 18 the operation of the surge control valve referenced

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329: 19 here?
 329: 20 A. It's the set point. I think we've been
 329: 21 through this before.

268 **331:2-332:9** Clark 12/07/2005
 331: 2 Q. Look at page 26029.
 331: 3 A. Okay.
 331: 4 Q. Is that the surge control valve command
 331: 5 schedule used by Honeywell in 1981?
 331: 6 A. Command schedule. It's the set -- It's
 331: 7 the Delta P/P set point in the surge control logic
 331: 8 versus IGV position.
 331: 9 Q. Will you read the title of Figure 11 on
 331: 10 page 26,029?
 331: 11 A. "Surge Control Command Schedule."
 331: 12 Q. Is Figure 11 the surge control command
 331: 13 schedule used by Honeywell in 1981?
 331: 14 MS. STEVENSON: Objection. Vague.
 331: 15 THE WITNESS: The plot shows the Delta
 331: 16 P/P set point versus IGV position.
 331: 17 Q. BY MR. LIND: Is that a yes or no?
 331: 18 MS. STEVENSON: Object to the form.
 331: 19 THE WITNESS: I'm just telling you what
 331: 20 the figure is.
 331: 21 Q. BY MR. LIND: Go ahead.
 331: 22 A. The figure shows a plot of the Delta P/P
 331: 23 set point that's used in the surge control logic
 331: 24 versus IGV position.
 331: 25 Q. Is it mislabeled, Figure 11?
 332: 1 A. Some people call the Delta P/P the
 332: 2 command. It's the set point. I would call it the
 332: 3 set point.
 332: 4 Q. Is the title of Figure 11, surge control
 332: 5 valve command schedule, true and accurate?
 332: 6 MS. STEVENSON: Object to the form.
 332: 7 THE WITNESS: I would not call it that.
 332: 8 I would call it the surge control valve set point
 332: 9 schedule.

269 **336:6-336:6** Clark 12/07/2005
 336: 6 Q. BY MR. LIND: Okay. Let me show you

270 **336:7-336:10** Clark 12/07/2005
 336: 7 Exhibit 22. Exhibit 22 is a December 16th, 1983,
 336: 8 memo from you to John Dannon.
 336: 9 Do you see that?
 336: 10 A. Yes, that's correct.

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271 **336:11-337:19** Clark 12/07/2005

336: 11 Q. Who is John Dannon?
 336: 12 A. John Dannon was the project engineer for
 336: 13 this engine that's called the GPG.
 336: 14 Q. Earlier in your testimony, you referenced
 336: 15 a surge control system for the GPG, but you weren't
 336: 16 positive that that was the acronym?
 336: 17 A. This is the one.
 336: 18 Q. Does this refresh your recollection that
 336: 19 the acronym that you were talking about, GPG, was, in
 336: 20 fact, GPG?
 336: 21 A. This is the same. This is it.
 336: 22 Q. This talks about test results of the GTCP
 336: 23 85-1000. That was an APU, correct?
 336: 24 A. That's an APU, that's correct.
 336: 25 Q. And what airplane did that APU go on?
 337: 1 A. I can't remember.
 337: 2 Q. Was the reference to the GPG surge
 337: 3 control a reference -- Is GPG a reference to the APU
 337: 4 or to a project name or what?
 337: 5 A. GPG -- it references -- that is some --
 337: 6 GPG is some designation for the engine and I can't
 337: 7 tell you what that acronym stands for.
 337: 8 Q. So is the GPG APU different from the
 337: 9 85-1000 APU?
 337: 10 A. I can't remember.
 337: 11 Q. What airplane did the GPG APU go on?
 337: 12 A. The GPG, I believe, was a ground cart.
 337: 13 It didn't go on an airplane. Ground carts are like
 337: 14 APUs that they can wheel around to different
 337: 15 aircraft.
 337: 16 Q. Does that mean that the GPG auxillary
 337: 17 power unit could be used basically for any aircraft
 337: 18 or a subset of aircrafts?
 337: 19 A. A subset of aircraft.

272 **339:2-339:16** Clark 12/07/2005

339: 2 Q. BY MR. LIND: Well, if you read the first
 339: 3 line to the introduction of the document, it says, "A
 339: 4 surge control system that is being investigated for
 339: 5 the GPG, will use static pressures located in the
 339: 6 diffuser to detect incipient surge."
 339: 7 Do you see that?
 339: 8 A. That's correct.
 339: 9 Q. Was that true?
 339: 10 A. That's true.

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339: 11 Q. So there was already, as of December of
 339: 12 1983, a surge control system that was being
 339: 13 investigated for the GPG that would use static
 339: 14 pressures located in the diffuser to detect incipient
 339: 15 surge, correct?
 339: 16 A. That's correct.

273 **339:25-340:11** Clark 12/07/2005
 339: 25 Q. When a surge control -- Before a surge
 340: 1 control system can be investigated, the surge control
 340: 2 system has to be designed, correct?
 340: 3 MS. STEVENSON: Objection. Vague.
 340: 4 THE WITNESS: I don't know if that's
 340: 5 completely true. You could be testing part of it
 340: 6 before the other parts are designed.
 340: 7 Q. BY MR. LIND: In order for a surge
 340: 8 control system to be investigated, the surge control
 340: 9 system has to be conceived, correct?
 340: 10 MS. STEVENSON: Objection. Vague.
 340: 11 THE WITNESS: At least parts of it.

274 **340:12-340:20** Clark 12/07/2005
 340: 12 Q. BY MR. LIND: And this document talks
 340: 13 about surge control system is going to use static
 340: 14 pressures located in the diffuser to detect incipient
 340: 15 surge, right?
 340: 16 A. That's correct.
 340: 17 Q. So by December 1983, Honeywell had
 340: 18 conceived of a surge control system that would use
 340: 19 static pressures located on the diffuser to detect
 340: 20 incipient surge, correct?

275 **340:23-341:2** Clark 12/07/2005
 340: 23 THE WITNESS: We put static pressures in
 340: 24 a -- There were two static taps, as I recall.
 340: 25 That's what formed this Delta P/P in the diffuser.
 341: 1 We had conceived that as of the date on this,
 341: 2 December 16th.

276 **341:3-341:4** Clark 12/07/2005
 341: 3 Q. BY MR. LIND: 1983?
 341: 4 A. 1983.

277 **343:17-343:23** Clark 12/07/2005
 343: 17 Q. BY MR. LIND: Did the GPG surge control
 343: 18 system that used static pressure measurements located
 343: 19 in the diffuser have the potential to experience the
 343: 20 double solution issue?
 343: 21 A. This Delta P -- This Delta P/Delta P did

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343: 22 not exhibit the -- what you call the double V
343: 23 solution.

278 **344:9-344:15** Clark 12/07/2005

344: 9 Q. Okay. So because the pressures in the
344: 10 GPG surge control system were being measured in the
344: 11 diffuser, did that surge control system have the
344: 12 potential, however, to exhibit the double solution
344: 13 curve?
344: 14 A. No. The Delta P/P does not exhibit the
344: 15 -- the inverted V curve.

279 **344:23-345:14** Clark 12/07/2005

344: 23 Q. BY MR. LIND: The third paragraph of the
344: 24 introduction of Exhibit 22 says, "Engine demo A had a
344: 25 diffuser instrumented to investigate the feasibility
345: 1 of these approaches."
345: 2 And when that says, "these approaches,"
345: 3 it's talking about the GPG surge control system and
345: 4 the alternative approach in the second paragraph,
345: 5 correct.
345: 6 A. I believe it's talking about the above
345: 7 approaches.
345: 8 Q. So is that yes?
345: 9 A. Yes.
345: 10 Q. It says, Testing on this engine showed
345: 11 that the Delta P/Delta P approach was the best
345: 12 scheme.
345: 13 Do you see that?
345: 14 A. That's correct.

280 **348:1-348:3** Clark 12/07/2005

348: 1 Q. BY MR. LIND: And the test involved the
348: 2 surge control system that used static pressure
348: 3 measurements located in the diffuser correct?

281 **348:6-348:8** Clark 12/07/2005

348: 6 THE WITNESS: This test is just for part
348: 7 of the system, the part that measures the pressures
348: 8 in the diffuser.

282 **348:19-348:21** Clark 12/07/2005

348: 19 Q. BY MR. LIND: And the part of the surge
348: 20 control system that you are testing would have to
348: 21 have been designed prior to the test plan, correct?

283 **348:24-349:7** Clark 12/07/2005

348: 24 THE WITNESS: I don't believe that's
348: 25 correct.

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349: 1 Q. BY MR. LIND: So how did you know what to
 349: 2 test if you didn't have a system design?
 349: 3 A. You -- For example, we're looking at two
 349: 4 different methods of measuring this parameter here.
 349: 5 All right. If you would have had the system design,
 349: 6 that seems to me like you would have already picked
 349: 7 one of those.

284 **350:13-350:18** Clark 12/07/2005

350: 13 Q. BY MR. LIND: Is it fair for me to call
 350: 14 the GPG surge control system that you reference in
 350: 15 your memo, Exhibit 22 "a surge control system"?
 350: 16 MS. STEVENSON: Objection. Vague.
 350: 17 THE WITNESS: No. The real -- The real
 350: 18 issue of this is just part of that system.

285 **350:19-350:24** Clark 12/07/2005

350: 19 Q. BY MR. LIND: In December of 1983,
 350: 20 Honeywell was investigating two different surge
 350: 21 control systems, one of them being a system that used
 350: 22 static pressure measurements located in the diffuser
 350: 23 to detect incipient surge. Isn't that right?
 350: 24 A. That's what the first sentence says.

286 **350:25-351:5** Clark 12/07/2005

350: 25 Q. Isn't that accurate?
 351: 1 A. That's what the first sentence says.
 351: 2 Q. Is it true or not?
 351: 3 A. I'm saying what's addressed in this memo
 351: 4 is we are measuring these pressures and finding out
 351: 5 their correlations to flow and pressures.

287 **351:23-352:2** Clark 12/07/2005

351: 23 Q. BY MR. LIND: Prior to December 16th of
 351: 24 1983, Honeywell tested a diffuser that had static
 351: 25 pressure taps to measure static pressure within the
 352: 1 diffuser, correct?
 352: 2 A. We tested that prior to this report.

288 **358:24-359:11** Clark 12/07/2005

358: 24 Q. And what do you -- When you use the word
 358: 25 "technology," generally what do you understand it to
 359: 1 mean?
 359: 2 A. Technology is some technical things used
 359: 3 to produce something.
 359: 4 Q. Based on that understanding, was there
 359: 5 any difference in the technology that existed in
 359: 6 December of 1983 that would have prevented the surge
 359: 7 control system referenced in the first paragraph of

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359: 8 Exhibit 22 to have been implemented two years before
 359: 9 that?
 359: 10 A. It doesn't require any -- Well -- it
 359: 11 doesn't -- It doesn't require any new technology.

289 **360:1-360:14** Clark 12/07/2005

360: 1 Q. I want to look at the conclusion. The
 360: 2 conclusion reads, "The information gained during this
 360: 3 test showed that the Delta P/Delta P type surge
 360: 4 control system is a promising concept."
 360: 5 By December of 1983, did Honeywell
 360: 6 believe that the surge control system described in
 360: 7 the first paragraph of Exhibit 22 was a promising
 360: 8 concept?
 360: 9 A. This isn't -- It may have used the word
 360: 10 "system" there, but this is still talking about the
 360: 11 Delta P -- it's talking about detecting surge using
 360: 12 Delta P/P. The word "system" is used, but it's
 360: 13 really talking about the promising concept is the
 360: 14 Delta P/P as a parameter that can detect surge.

290 **362:13-362:19** Clark 12/07/2005

362: 13 Q. Is there any part of the Delta P/Delta P
 362: 14 surge control system that had not been developed by
 362: 15 December of 1983?
 362: 16 A. Knowing that the Delta P/Delta P concept
 362: 17 or mark had not been developed prior to this. And
 362: 18 that's part of the system. That's why we ran this
 362: 19 test.

291 **365:3-365:14** Clark 12/07/2005

365: 3 Q. And prior to December of 1983, going all
 365: 4 the way back into the late '70s, it was your
 365: 5 understanding that in order to control for surge, you
 365: 6 would need to take into account inlet guide vane
 365: 7 angle as an input into the surge control system,
 365: 8 correct?
 365: 9 A. I have to explain that.
 365: 10 We've already gone through -- the F-18
 365: 11 doesn't do that. Under some circumstances, if you're
 365: 12 allowing to give up, depending on how fine you want
 365: 13 to control surge, you can build a surge control
 365: 14 system that doesn't do that because F-18 does.

292 **365:17-365:22** Clark 12/07/2005

365: 17 Prior to December 1983, going all the way
 365: 18 back into the late '70s, it was your understanding
 365: 19 that in order to efficiently control surge, you would

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365: 20 need to take into account inlet guide vane angle and
 365: 21 input into your surge control system, correct?
 365: 22 A. I believe that statement is correct.

293 **366:16-366:22** Clark 12/07/2005

366: 16 Q. And you do -- Did you do the
 366: 17 calculations on page 74 based on the test data that
 366: 18 was collected?
 366: 19 A. This says, "The GTC 85-100 compressor
 366: 20 map." I can't say whether that was the test data
 366: 21 collected during our test or if this map was given to
 366: 22 me.

294 **367:21-367:25** Clark 12/07/2005

367: 21 Q. Are each of the curved lines on page 74
 367: 22 represent different inlet guide vane angle?
 367: 23 A. This engine does not have inlet guide
 367: 24 vanes. You see them 70 percent, 80 percent, 90
 367: 25 percent, 100 percent. Those would be speeds.

295 **369:6-369:16** Clark 12/07/2005

369: 6 Well, tell me what's shown on the graph
 369: 7 on page 90 of Exhibit 22.
 369: 8 A. There is a Delta P/P. I'm not sure
 369: 9 exactly what parameters make up that Delta P/P, but
 369: 10 the other parameter is corrected flow. The Y axis is
 369: 11 correct flow and the X axis would be Delta P/P.
 369: 12 Q. Those are the same axes that we use on
 369: 13 our compressor maps, correct?
 369: 14 A. No. The -- This would be discharge
 369: 15 corrected flow. On the compressor maps, you plot
 369: 16 inlet corrected flow.

296 **369:20-370:18** Clark 12/07/2005

369: 20 Q. When you say, "At the top of this graph,
 369: 21 diffuser Delta P/P," what does that relate to or
 369: 22 refer to?
 369: 23 A. I don't know. It's not labeled and it
 369: 24 doesn't show on a diagram, so I don't know what that
 369: 25 ...
 370: 1 Q. Did you draw this graph?
 370: 2 A. I did draw the graph.
 370: 3 Q. Does this graph on page 90 show a double
 370: 4 solution curve?
 370: 5 A. No, it does not.
 370: 6 Q. Does the graph on page 90 -- What is the
 370: 7 significance of the peak on the right-hand side of
 370: 8 the graph on page 90?

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370: 9 A. If you notice the scale, it goes up here
 370: 10 and then this part of the curve is that scale and
 370: 11 this part of the curve is that scale. So you notice
 370: 12 this scale is -- is increasing in value as it goes
 370: 13 down.
 370: 14 Q. So you ran out of paper?
 370: 15 A. I ran out of paper.
 370: 16 Q. Pretty much why this curve looks like it
 370: 17 does?
 370: 18 A. That's correct.

297 **375:22-376:24** Clark 12/07/2005

375: 22 Q. First sentence reads. "The main
 375: 23 assumption in the development of the 131 logic is
 375: 24 that surge will be caused by aerodynamic stall in the
 375: 25 diffuser."
 376: 1 Did you see that?
 376: 2 A. Yes.
 376: 3 Q. Why did you assume that surge would be
 376: 4 caused by aerodynamic stall in the diffuser?
 376: 5 A. That information came from the compressor
 376: 6 designer.
 376: 7 Q. Was there something different about the
 376: 8 131 that would cause -- from other APUs, that would
 376: 9 cause surge to be the result of an aerodynamic stall
 376: 10 in the diffuser?
 376: 11 A. As I recall, what the compressor designer
 376: 12 said that this was a centrifugal compressor with the
 376: 13 diffuser. And he said we have this arrangement --
 376: 14 what causes a surge is -- initiates the surge is
 376: 15 stall in the diffuser vanes.
 376: 16 Q. When you have a centrifugal compressor
 376: 17 with a diffuser in that case, are those types of APUs
 376: 18 the surge will be caused by an aerodynamic stall in
 376: 19 the diffuser?
 376: 20 A. That's correct.
 376: 21 Q. And that's just based on concepts of
 376: 22 fluid dynamics and flow?
 376: 23 A. That's based on what the compressor
 376: 24 designer -- his experience and knowledge.

298 **380:7-380:10** Clark 12/07/2005

380: 7 Q. Was your Delta P/Delta P surge control
 380: 8 system that measured static pressure in the diffuser
 380: 9 ever implemented on the 331-200?
 380: 10 A. No.

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299 **380:23-381:15** Clark 12/07/2005
 380: 23 Q. BY MR. LIND: At the bottom, the last
 380: 24 bullet of page 555 says, "A version of this system is
 380: 25 currently in development on an engine program
 381: 1 scheduled for production in 1988."
 381: 2 What engine program are they talking
 381: 3 about -- is Honeywell talking about?
 381: 4 A. The only -- The only engine program the
 381: 5 he ever used this on would be the 131-3.
 381: 6 Q. When you say, "used this," what do you
 381: 7 mean by "this"?
 381: 8 A. The Delta P/Delta P.
 381: 9 Q. And so you understand page 555 to be
 381: 10 talking about the Delta P/Delta P surge control
 381: 11 system, correct?
 381: 12 MS. STEVENSON: Objection. Misstates
 381: 13 testimony.
 381: 14 THE WITNESS: That last bullet. I
 381: 15 wouldn't speculate on the other bullets.

300 **382:18-382:18** Clark 12/07/2005
 382: 18 (Exhibit 25 was marked for identification.)

301 **382:19-383:10** Clark 12/07/2005
 382: 19 Q. BY MR. LIND: I'm going to hand you
 382: 20 Exhibit 25. Exhibit 25 is a May 1989 memo written by
 382: 21 Ed Goff titled, "Selection of Static Pressure Pick Up
 382: 22 For Surge Control."
 382: 23 Do you have that before you?
 382: 24 A. I have that before me.
 382: 25 Q. What does "static pressure pick up" mean
 383: 1 in relation to surge control? Is that referring to
 383: 2 where you measure static pressure?
 383: 3 A. I'm looking further down in the document
 383: 4 and I see that they have this Delta P/P total. So
 383: 5 that would be the static pressure in the Delta P.
 383: 6 Q. By the date of the memo that is Exhibit
 383: 7 25, Honeywell had been measuring static pressure in
 383: 8 the diffuser in a way that was resulting in the
 383: 9 double solution problem, right?
 383: 10 A. I can't see that from this memo.

302 **383:11-383:13** Clark 12/07/2005
 383: 11 Q. Exhibit 25 relates to the 331-350 APU,
 383: 12 correct?
 383: 13 A. Correct.

303 **383:20-384:14** Clark 12/07/2005

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383: 20 Q. The 331-350 APU experienced the double
 383: 21 solution problem, correct?
 383: 22 A. That's correct.
 383: 23 Q. The 331-350 APU used inlet guide vane
 383: 24 position as an input in determining when you're on
 383: 25 the right-hand side of the double solution curve,
 384: 1 correct?
 384: 2 A. That's correct.
 384: 3 Q. The 331-350 APU used inlet guide vane
 384: 4 position as an input in determining whether to
 384: 5 override the surge control system if you are on that
 384: 6 --
 384: 7 A. Told you which --
 384: 8 Q. -- high flow area of the double solution
 384: 9 curve, correct?
 384: 10 A. I believe that's correct.
 384: 11 Q. If you turn the page -- to the last page
 384: 12 of Exhibit 25, there are two graphs plotted here,
 384: 13 correct?
 384: 14 A. That's correct.

304 **384:23-384:25** Clark 12/07/2005

384: 23 Q. As the -- When did the 331-350 first
 384: 24 exhibit the double solution characteristic?
 384: 25 A. I don't -- I don't know.

305 **385:22-386:5** Clark 12/07/2005

385: 22 Q. Turbomeca supplied the compressor for the
 385: 23 331-350?
 385: 24 A. That's correct.
 385: 25 Q. Did Turbomeca design the load compressor
 386: 1 for the 331-350?
 386: 2 A. I don't know.
 386: 3 Q. When did you first see double solution
 386: 4 curves like the ones on the last page of Exhibit 25?
 386: 5 A. I can't remember.

306 **386:6-386:10** Clark 12/07/2005

386: 6 Q. But you agree that the graphs on the last
 386: 7 page of Exhibit 5 show the double solution
 386: 8 characteristic, right?
 386: 9 A. Both graphs show the double -- the
 386: 10 inverted V characteristic.

307 **413:8-413:17** Clark 12/07/2005

413: 8 Q. BY MR. LIND: Was it known back in the
 413: 9 late '70s that if you took pressure measurements that
 413: 10 intruded into compressor flow spaces, that that would

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413: 11 be a bad thing, that you would lose energy?
 413: 12 A. I think we've talked about that before.
 413: 13 You wouldn't want to put a probe in a diffuser.
 413: 14 Q. And you've known that since the late
 413: 15 1970s, correct?
 413: 16 A. People have known that since the late
 413: 17 1970s.

308 **423:13-423:20** Clark 12/07/2005
 423: 13 Q. Do you understand the 302 patent to
 423: 14 relate to avoiding surge?
 423: 15 MS. STEVENSON: Objection. Lacks
 423: 16 foundation. And I object to this entire line of
 423: 17 questioning.
 423: 18 Mr. Clark is here as a fact witness. He
 423: 19 is not an expert witness, and he's not here to give
 423: 20 opinion testimony.

309 **428:10-428:15** Clark 12/07/2005
 428: 10 Q. BY MR. LIND: Sir, I'm handing you what's
 428: 11 been marked as Hamilton Remand Exhibit 29. This is
 428: 12 the United States patent number 4164033, dated August
 428: 13 7th, 1979, to a -- issued to Mr. Glennon and others.
 428: 14 Do you have that before you?
 428: 15 A. I have that before me.

310 **429:18-429:24** Clark 12/07/2005
 429: 18 Q. BY MR. LIND: The Glennon 033 patent
 429: 19 relates to compressor surge control, correct?
 429: 20 MS. STEVENSON: Objection. Lacks
 429: 21 foundation.
 429: 22 THE WITNESS: I'm looking at this. I do
 429: 23 see a compressor map. I do not see one in the figure
 429: 24 there.

311 **431:7-431:10** Clark 12/07/2005
 431: 7 Q. Do you understand the Glennon 033 patent
 431: 8 to relate to a surge control system?
 431: 9 A. Yes, it's trying to prevent surge as it's
 431: 10 stated there.

312 **434:16-435:8** Clark 12/07/2005
 434: 16 Q. And the inlet -- Does the inlet guide
 434: 17 vane position in the Glennon patent affect the
 434: 18 reference pressure ratio?
 434: 19 MS. STEVENSON: Objection. Lacks
 434: 20 foundation.
 434: 21 THE WITNESS: I'm reading that sentence
 434: 22 and it doesn't appear what that sentence is saying.

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434: 23 It's saying -- It's saying that there's lesser rate
 434: 24 flow for rate, and that has occurred because of
 434: 25 either decreasing speed or repositioning of the inlet
 435: 1 guide vanes.
 435: 2 Q. BY MR. LIND: Does the Glennon patent
 435: 3 disclose that the inlet guide vane position will
 435: 4 affect the reference pressure ratio?
 435: 5 MS. STEVENSON: Objection. Calls for a
 435: 6 legal conclusion and lacks foundation.
 435: 7 THE WITNESS: No, I don't believe so. I
 435: 8 don't -- I don't see anything saying that.

313 **436:13-436:15** Clark 12/07/2005

436: 13 Q. Does the Glennon 033 patent describe the
 436: 14 use of inlet guide vane position as an input into the
 436: 15 surge control system?

314 **436:18-436:18** Clark 12/07/2005

436: 18 THE WITNESS: Yes, I think it does.

315 **436:19-437:7** Clark 12/07/2005

436: 19 Q. BY MR. LIND: And does the Glennon 033
 436: 20 patent describe a surge control system where a
 436: 21 pressure -- a reference pressure ratio is compared to
 436: 22 a measured pressure ratio in order to control surge?
 436: 23 MS. STEVENSON: Objection. Lacks
 436: 24 foundation. Calls for speculation and calls for
 436: 25 improper expert testimony.
 437: 1 THE WITNESS: I'm seeing inlet guide on
 437: 2 Figure 2. I'm seeing an inlet guide vane and/or
 437: 3 speed information being fed into this summer and I'm
 437: 4 seeing a P reference circuit. At that point, I can't
 437: 5 speculate if that's feedback from a pressure ratio
 437: 6 coming from the device and this inlet guide vane box
 437: 7 number 94 is putting out a set point.

316 **437:17-438:1** Clark 12/07/2005

437: 17 Q. BY MR. LIND: Do you agree that the inlet
 437: 18 guide vane position in the Glennon patent affects the
 437: 19 signal that will be sent to the surge valve?
 437: 20 MS. STEVENSON: Lacks foundation. Calls
 437: 21 for speculation and improper expert testimony.
 437: 22 THE WITNESS: I don't quite know what box
 437: 23 74 is. It's labeled -- To answer that question I
 437: 24 would have to know more about what box 74 in Figure 2
 437: 25 of the patent is. The label on it is, "Inlet Guide
 438: 1 Vane and/or Speed Information."

317 **438:12-439:5** Clark 12/07/2005

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438: 12 Q. BY MR. LIND: Do you agree that the inlet
 438: 13 guide vane position in the Glennon patents affects
 438: 14 the signal that is sent to the surge valve?
 438: 15 MS. STEVENSON: Objection. Lacks
 438: 16 foundation. Calls for speculation. Calls for
 438: 17 improper expert testimony.
 438: 18 THE WITNESS: The box -- This is what it
 438: 19 says about box 74. It says, "This may" --
 438: 20 Q. BY MR. LIND: Sir, can you just try and
 438: 21 answer the question?
 438: 22 MS. STEVENSON: Let's let the witness
 438: 23 finish what he was saying.
 438: 24 THE WITNESS: I want to finish, please.
 438: 25 It says, "This may be most easily
 439: 1 accomplished by adding a signal representative to a
 439: 2 shift some of 36," and that's shown I believe in
 439: 3 Figure 2, "by an inlet guide vane or speed
 439: 4 information circuit." That still doesn't tell me
 439: 5 what that circuit does -- what that is.

318 **439:16-439:18** Clark 12/07/2005

439: 16 Q. BY MR. LIND: Does Glennon teach the
 439: 17 basic concept that the inlet guide vane position will
 439: 18 affect where you are on the compressor map?

319 **439:21-439:24** Clark 12/07/2005

439: 21 THE WITNESS: The Figure 1 of the patent,
 439: 22 Exhibit 29, has a compressor map, which is a generic
 439: 23 compressor map, and it shows that the compressor
 439: 24 characteristics are shifting with IGV lines.

320 **442:2-442:17** Clark 12/07/2005

442: 2 Q. BY MR. LIND: And then does the Glennon
 442: 3 patent have to reposition the -- or, change the
 442: 4 reference pressure ratio set point in response to the
 442: 5 change in that vane position?

442: 6 MS. STEVENSON: Objection. Calls for
 442: 7 speculation. Lacks foundation. Calls for expert
 442: 8 testimony.

442: 9 THE WITNESS: I don't interpret that
 442: 10 sentence to say that.

442: 11 Q. BY MR. LIND: How is, in the Glennon
 442: 12 patent, your understanding, the reference set
 442: 13 point -- the reference pressure ratio set point set?

442: 14 MS. STEVENSON: Objection. Lacks
 442: 15 foundation. Calls for speculation.

442: 16 THE WITNESS: I can't tell. It's not on

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442: 17 this diagram.

321 **442:18-442:22** Clark 12/07/2005

442: 18 Q. BY MR. LIND: Will you read the top of
442: 19 column 3?

442: 20 A. Okay.

442: 21 Q. Does that tell you how the reference

442: 22 pressure ratio is used in Glennon?

322 **443:1-443:11** Clark 12/07/2005

443: 1 THE WITNESS: That tells me there's a
443: 2 point on the line where they're trying to maintain
443: 3 that -- maintain that point.

443: 4 Q. BY MR. LIND: And that point is --

443: 5 You understand Glennon to teach that
443: 6 there's a point on the operating line called the
443: 7 pressure ratio reference point --

443: 8 A. Correct.

443: 9 Q. -- that the system's trying to maintain,
443: 10 correct?

443: 11 A. Correct.

323 **444:8-444:16** Clark 12/07/2005

444: 8 Q. You can tell by looking at Figure 1 of
444: 9 Glennon that the pressure ratio reference value
444: 10 shifts to the left as the inlet guide vane position
444: 11 becomes more closed?

444: 12 A. I see a point on there labeled "Reference
444: 13 Pressure." I see another thing on there, a dashed
444: 14 line labeled "Operating Line." I don't see anything
444: 15 that indicates that the reference pressure moves up
444: 16 and down the operating line.

324 **450:3-450:14** Clark 12/07/2005

450: 3 Q. Does the Glennon -- Does the Glennon
450: 4 patent also teach that temperature affects where you
450: 5 are on the compressor map?

450: 6 MS. STEVENSON: Objection. Calls for a
450: 7 legal conclusion and calls for speculation. Lacks
450: 8 foundation.

450: 9 THE WITNESS: Not -- I don't see that.
450: 10 That parameter I'm looking at is what you call
450: 11 corrected inlet flow. The compressor map -- the way
450: 12 they do compressor maps is -- The reason they
450: 13 correct it like that is the map looks the same
450: 14 depending on the temperature.

325 **451:1-451:6** Clark 12/07/2005

451: 1 Q. And does that show you that temperature

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451: 2 affects where you are on the compressor map?
 451: 3 MS. STEVENSON: Objection. Vague.
 451: 4 THE WITNESS: As you stated the question,
 451: 5 no. You'd need more than temperature to know where
 451: 6 you are on the compressor map.

326 **452:1-452:6** Clark 12/07/2005

452: 1 Q. Does the Glennon 033 patent surge control
 452: 2 system use temperature as an input?
 452: 3 MS. STEVENSON: Objection. Lacks
 452: 4 foundation.
 452: 5 THE WITNESS: I don't see that. I don't
 452: 6 see that it uses temperature as an input.

327 **459:18-459:22** Clark 12/07/2005

459: 18 Q. BY MR. LIND: Exhibit 31 is an article
 459: 19 called, "Surge Control For Centrifugal Compressors,"
 459: 20 written by M.H. White and dated December 25th, 1972.
 459: 21 Do you have that before you?
 459: 22 A. I have that before me.

328 **461:8-461:13** Clark 12/07/2005

461: 8 Q. In connection with submitting your
 461: 9 declaration earlier in this case, you read the White
 461: 10 article, correct?
 461: 11 MS. STEVENSON: Objection. Vague.
 461: 12 THE WITNESS: I read a White article.
 461: 13 I'm not sure this is the same article.

329 **462:8-462:15** Clark 12/07/2005

462: 8 Did you form opinions about the White
 462: 9 article when you filed your declaration earlier in
 462: 10 this case?
 462: 11 MS. STEVENSON: Objection. Asked and
 462: 12 answered and vague.
 462: 13 THE WITNESS: I'm saying I formed an
 462: 14 opinion about a White article. I'm not sure it's
 462: 15 this White article in front of me.

330 **463:1-463:13** Clark 12/07/2005

463: 1 Q. You compared the White article to the
 463: 2 claims of the patents in the '893 and '194 patents
 463: 3 when you submitted your declaration earlier in this
 463: 4 case, right?
 463: 5 A. That's the first sentence of paragraph
 463: 6 17.
 463: 7 Q. Is that a yes?
 463: 8 A. That's a yes.
 463: 9 Q. And you distinguished the claims of the

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463: 10 '893 and '194 patents from the White article because,
 463: 11 quote, there is no mention of maintaining a constant
 463: 12 flow of air despite changes in demand for air,
 463: 13 correct?

331 **463:15-463:22** Clark 12/07/2005

463: 15 THE WITNESS: That's what the sentence
 463: 16 says, correct.
 463: 17 Q. BY MR. LIND: And you say, "That's what
 463: 18 the sentence says," you're talking about the sentence
 463: 19 in your declaration?
 463: 20 A. Yes. For example, there is no mention of
 463: 21 maintaining a constant flow of air despite changes in
 463: 22 demand for air.

332 **463:23-464:10** Clark 12/07/2005

463: 23 Q. When you filed your declaration under
 463: 24 oath earlier in this case, you did not make any
 463: 25 distinction between the '194 and '893 patents and the
 464: 1 White article based on the use of inlet guide vane
 464: 2 position, correct?
 464: 3 MS. STEVENSON: Objection. Misstates the
 464: 4 document.
 464: 5 THE WITNESS: I don't -- I don't see
 464: 6 inlet guide being mentioned. And I don't know what
 464: 7 these claims are in patent '194 and '893 patent
 464: 8 claims, so I couldn't agree with that. The answer
 464: 9 would be, I don't know. I would have to have more
 464: 10 information.

333 **464:11-464:16** Clark 12/07/2005

464: 11 Q. BY MR. LIND: In your declaration that
 464: 12 you filed under oath in this case --
 464: 13 A. Correct.
 464: 14 Q. -- you tried to distinguish the White
 464: 15 article from claims of the '893 and '194 patents,
 464: 16 correct?

334 **464:19-464:22** Clark 12/07/2005

464: 19 THE WITNESS: That's what the first
 464: 20 sentence says to me.
 464: 21 Q. BY MR. LIND: Is that a yes?
 464: 22 A. That's a yes.

335 **464:25-465:15** Clark 12/07/2005

464: 25 Q. BY MR. LIND: And when you tried to
 465: 1 distinguish the White article from the patents that
 465: 2 Honeywell asserts in this case, you didn't make any
 465: 3 distinction based on inlet guide vane position; is

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465: 4 that correct?
 465: 5 MS. STEVENSON: Objection. Misstates the
 465: 6 document.
 465: 7 THE WITNESS: Just from this, I can't say
 465: 8 if that's true. It says, "The White article does not
 465: 9 include limitations on the '194 patent," and it gives
 465: 10 element 14C. I don't know what that is. We would
 465: 11 have to go back and look.
 465: 12 Q. BY MR. LIND: Anywhere in paragraph 17 of
 465: 13 your sworn, under oath declaration, did you make any
 465: 14 reference to distinguishing the White article based
 465: 15 on inlet guide vane position?

336 **465:18-465:22** Clark 12/07/2005

465: 18 THE WITNESS: I don't know if inlet guide
 465: 19 vane is mentioned in these claims.
 465: 20 Q. BY MR. LIND: Did you discuss inlet guide
 465: 21 vane position or the use of inlet guide vane position
 465: 22 anywhere in paragraph 17?

337 **465:25-466:20** Clark 12/07/2005

465: 25 THE WITNESS: I'm claiming at paragraph
 466: 1 17, part of that is the element one and 4C of the
 466: 2 patents. And I don't -- I don't know if those
 466: 3 mentioned inlet guide vanes or not. So I can't
 466: 4 answer your question.
 466: 5 Q. BY MR. LIND: Did you say anything about
 466: 6 -- Did you use the words "inlet guide vane" or
 466: 7 "inlet guide vane position" in making your
 466: 8 distinction between the White article and the patents
 466: 9 Honeywell's asserting here?
 466: 10 A. I would have to go look at those.
 466: 11 Q. I just want you to look at paragraph 17.
 466: 12 A. I want to look up element 14C.
 466: 13 Q. That's fine. What I'd like you to do
 466: 14 first is answer my question.
 466: 15 When you claim 17, do you use the words
 466: 16 "inlet guide vane position" anywhere in trying to
 466: 17 distinguish the White article from the patents that
 466: 18 Honeywell's asserted?
 466: 19 A. As far as I'm concerned, I need to look
 466: 20 at these claims.

338 **470:1-471:2** Clark 12/07/2005

470: 1 Q. Why don't you read that two inches on the
 470: 2 bottom of the first column and the two inches on the
 470: 3 top of the second column -- three inches.

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470: 4 A. Okay. I read the first column there.
 470: 5 Q. Go ahead and continue that whole section
 470: 6 into the second column.
 470: 7 A. Okay.
 470: 8 Q. Do you agree that White teaches
 470: 9 incorporating the position of the inlet guide vanes
 470: 10 into the surge control system?
 470: 11 A. He's saying that there is a surge line
 470: 12 for each vane position just as there is for a
 470: 13 temperature. And then I believe up here, I see the
 470: 14 sentence, "Where it also provides an unnecessary
 470: 15 required safety margin when the vanes are moved in a
 470: 16 prerotation direction. This could result in
 470: 17 bypassing gas at times when it is nonrequired."
 470: 18 Okay. So that is what we have talked
 470: 19 about in previous discussions on resetting the surge
 470: 20 control set point within the inlet guide vanes.
 470: 21 Q. Does the White article teach using the
 470: 22 inlet guide vane position to set the set points in
 470: 23 the surge control system?
 470: 24 MS. STEVENSON: Objection. Lacks
 470: 25 foundation.
 471: 1 THE WITNESS: I don't see that
 471: 2 specifically.

339 **471:12-471:14** Clark 12/07/2005

471: 12 Q. Do you agree that White teaches
 471: 13 incorporating the position of the inlet guide vanes
 471: 14 into the surge control system?

340 **471:17-471:20** Clark 12/07/2005

471: 17 THE WITNESS: That appears to be what
 471: 18 he's talking about in the sentence.
 471: 19 Q. BY MR. LIND: Yes?
 471: 20 A. Yes.

341 **471:21-471:22** Clark 12/07/2005

471: 21 Q. Does White therefore teach setting the
 471: 22 set point based on inlet guide vane position?

342 **471:25-472:1** Clark 12/07/2005

471: 25 THE WITNESS: It sounded like the
 472: 1 previous question to me, so I'd have the same answer.

343 **472:2-472:3** Clark 12/07/2005

472: 2 Q. BY MR. LIND: Yes?
 472: 3 A. I said "the same answer."

344 **472:4-472:11** Clark 12/07/2005

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472: 4 Q. Okay. It talks about in White the ratio
 472: 5 setting. Do you see that in the sentence we just
 472: 6 read?
 472: 7 A. I did see that.
 472: 8 Q. And the ratio setting in the White surge
 472: 9 control system is the flow-related parameter,
 472: 10 correct?
 472: 11 A. I believe that's correct.

345 **472:12-473:7** Clark 12/07/2005

472: 12 Q. Does White then teach the use of inlet
 472: 13 guide vane position to adjust the flow-related
 472: 14 parameter?
 472: 15 MS. STEVENSON: Objection. Lacks
 472: 16 foundation. Calls for speculation.
 472: 17 THE WITNESS: I'm actually checking to
 472: 18 see what that -- the pressure ratio parameter is. So
 472: 19 I'm trying to see what ratio he's referred to.
 472: 20 Q. BY MR. LIND: Tell me when you're done.
 472: 21 A. Still working on what the ratio is. I
 472: 22 see these figures here. Trying to -- there's a ratio
 472: 23 setting. Okay. It says, under ratio setting with
 472: 24 the controller I've established -- I'm reading from
 472: 25 the White under ratio setting with the controller
 473: 1 I've established as in Figure 3. Okay.
 473: 2 There's Figure 3 and that is a
 473: 3 relationship of H and water, which I do not know what
 473: 4 it is to some type of a Delta P. And he's talking
 473: 5 about the -- the slope of that line. Not knowing
 473: 6 what H and water is, I don't know what his parameter
 473: 7 is here. I don't know what the ratio parameter is.

346 **473:8-473:9** Clark 12/07/2005

473: 8 Q. Is the -- is the parameter in White a
 473: 9 function of the inlet guide vane position?

347 **473:12-473:14** Clark 12/07/2005

473: 12 THE WITNESS: Whatever that ratio is, the
 473: 13 sentence says that it's changed within that guide
 473: 14 vane position.

348 **473:15-473:19** Clark 12/07/2005

473: 15 Q. BY MR. LIND: So is the flow-related
 473: 16 parameter in White a function of the inlet guide vane
 473: 17 position?
 473: 18 A. I cannot tell if the ratio is the
 473: 19 flow-related parameter.

349 **476:4-476:9** Clark 12/07/2005

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476: 4 Q. Is the compression ratio a flow-related
 476: 5 parameter in White, then?
 476: 6 A. I don't consider that a flow-related
 476: 7 parameter. I define a flow-related parameter as you
 476: 8 tell me what that parameter is and I'll tell you the
 476: 9 flow regardless of other parameters.

350 **476:10-476:11** Clark 12/07/2005

476: 10 Q. Is the compression ratio an indicator of
 476: 11 flow?

351 **476:13-476:18** Clark 12/07/2005

476: 13 THE WITNESS: If the word indicated means
 476: 14 the other things that could affect flow are constant,
 476: 15 like, there are several lines on this map, there are
 476: 16 speed lines and there could be temperature lines.
 476: 17 Given those things are constant, then the pressure
 476: 18 issue, you can determine flow.

352 **478:4-478:7** Clark 12/07/2005

478: 4 Q. BY MR. LIND: So based on that, the inlet
 478: 5 guide vane position is a factor in controlling the
 478: 6 operation of the surge bleed valve, correct?
 478: 7 A. That's correct.

353 **483:9-483:15** Clark 12/07/2005

483: 9 Q. Do you understand White to teach that the
 483: 10 equipment in Figure 7 may, of course, be either
 483: 11 pneumatic or electronic?
 483: 12 A. There's quite a bit of equipment in
 483: 13 Figure 7. There's that surge controller and there's
 483: 14 also the instrumentation. I'm not sure which
 483: 15 equipment it refers to.

354 **491:3-492:12** Clark 12/07/2005

491: 3 Q. Okay. Look at the first page of Exhibit
 491: 4 27, AS225.
 491: 5 Do you see that?
 491: 6 A. Yes.
 491: 7 Q. It talks about the GTCP 36-300 APU?
 491: 8 A. Correct.
 491: 9 Q. What airplane did the 36-300 go on?
 491: 10 A. I can't tell you the -- I can tell you
 491: 11 the company. It was an air bus. I cannot tell you
 491: 12 exactly what airplane it went on.
 491: 13 Q. But it was a commercial airplane?
 491: 14 A. It was a commercial APU. It went on an
 491: 15 air bus airplane. Exactly which one, I do not know.
 491: 16 Q. Air bus 320, does that ring a bell?

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491: 17 Don't know?
 491: 18 A. Don't know.
 491: 19 Q. Okay. You were copied on the document
 491: 20 that starts at page 225, AS225?
 491: 21 A. Yes.
 491: 22 Q. Describe the surge control system that
 491: 23 was used in the 36-300 APU.
 491: 24 A. The control system that was used in the
 491: 25 36-300 was very similar to the one we used in the
 492: 1 331-250 and 200. It had a -- I didn't work on it,
 492: 2 so it was Ed Goff. But as I recall, it was like the
 492: 3 331-200 and 250.
 492: 4 Q. Did the surge control system in the
 492: 5 36-300 use inlet guide vane position to solve the
 492: 6 double solution issue?
 492: 7 A. I don't know. Actually, it did not have
 492: 8 diffuser statics, so it would not have had that
 492: 9 problem.
 492: 10 Q. The 36-300 did not measure pressure --
 492: 11 static pressure in the diffuser?
 492: 12 A. I believe that's correct.

355 **494:17-494:22** Clark 12/07/2005

494: 17 Q. BY MR. LIND: Focusing back on the
 494: 18 document that is AS253 through AS255. Can you tell
 494: 19 from looking at that document that it relates to the
 494: 20 131-3?
 494: 21 A. Yes, I recognize the surge system on page
 494: 22 255 as the 131-3.

356 **495:21-496:2** Clark 12/07/2005

495: 21 Q. If we turn the page to AS255, is that a
 495: 22 diagram of the surge control system described in your
 495: 23 817 patent?
 495: 24 A. The sensing system there where you see
 495: 25 the Delta P high and Delta P low and then you see a
 496: 1 division of Delta P high and Delta P low is the
 496: 2 patent that you referenced.

357 **501:25-502:16** Clark 12/07/2005

501: 25 Q. When you wrote your December 1983 memo,
 502: 1 had you selected yet what that specific numeric set
 502: 2 point would be?
 502: 3 A. That -- that -- that subpoint has changed
 502: 4 with different engine -- In this case, we looked at
 502: 5 it and it was .3. When we ran tests, in this case,
 502: 6 it looks like it's gone to .6.

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502: 7 Q. When you described in your December 1983
502: 8 memo your Delta P/Delta P surge control that utilized
502: 9 the pressure -- the static pressure measurements and
502: 10 the diffuser, you didn't have a firm fixed set point
502: 11 number, right?
502: 12 A. I see it on here and expect surge to
502: 13 occur at .3. So as far as a sub -- All we know is
502: 14 there is -- this is not designed in the system. It's
502: 15 only looking at the full sentence and see if it
502: 16 defects full surge.

358 502:23-503:1 Clark 12/07/2005

502: 23 THE WITNESS: Exhibit 22.
502: 24 Q. BY MR. LIND: You're pointing to Exhibit
502: 25 22?
503: 1 A. I'm pointing to Exhibit 22.

Total time for all Scripts in this report: 02:34:53